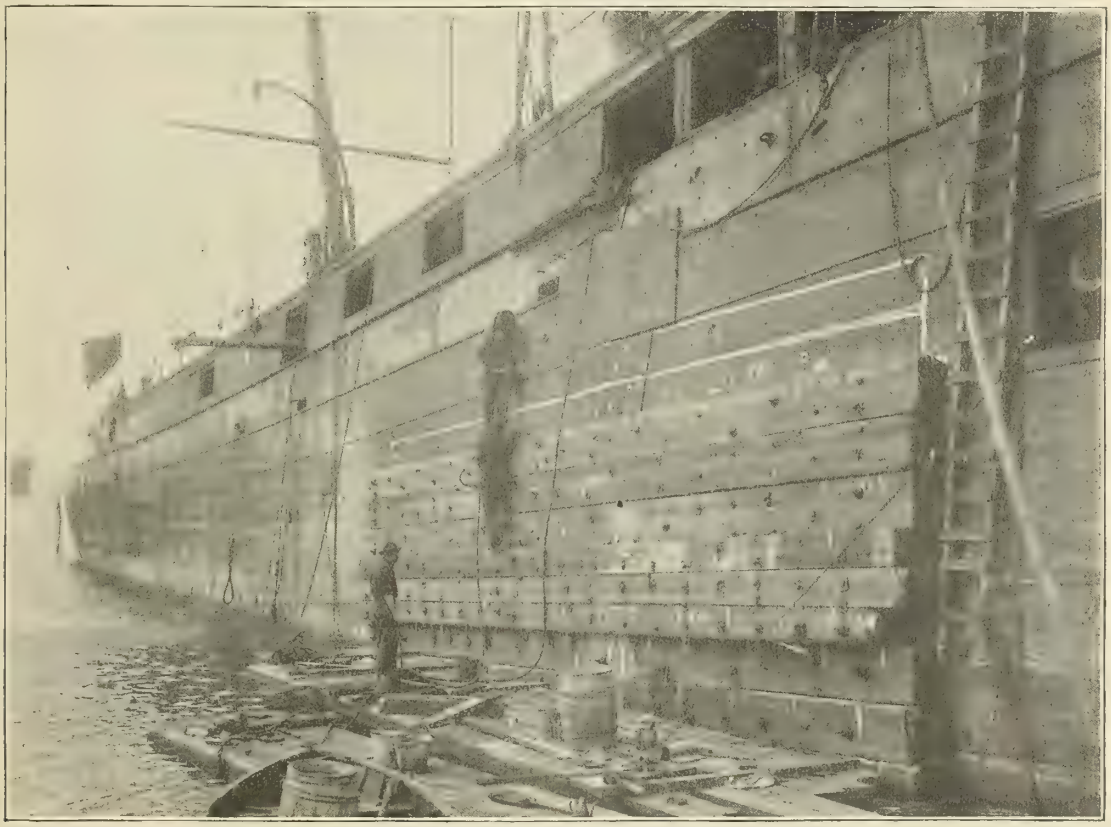
Marine Engineering

Vol. 6. NEW YORK, OCTOBER, 1901. No. 10.

SALVING OF THE STEAMSHIP WILLAMETTE.

On the 16th day of March, 1901, the steamship *Willamette*, belonging to the Pacific Coast Steamship Co., while running from Comox, B. C., with 900 tons of coal cargo to Ladysmith, B. C., to finish loading, ran on submerged rocks off Denman Island, in Union Bay, British Columbia.

It was immediately seen that the position of the vessel was hopelessly perilous, and she was abandoned. The vessel came to rest on the rocks at a point amidship under the main boilers and the hull structure, be-



WOODEN SPLICE OVER THE BREAK IN THE HULL OF THE WILLAMETTE.

ing weakest at this point, with a partial cargo of coal at both ends of the vessel, soon broke in two, the outside plating parting abreast the fireroom on both sides.

The hull being broken in two parts, it was deemed impracticable to salve the vessel, and the wreck was sold by the underwriters on April 16, 1901. Mr. Robert Moran, president of Moran Bros. Company, Seattle, Wash., who had visited the wreck previous to the sale thereof, conceived the idea of joining the two parts together and floating the vessel, the accomplishment of what was considered an impossible feat by experienced men. He purchased the vessel at the underwriters' sale with the idea of conducting salving operations with an outfit from the company's works at Seattle. He believed from previous experience and from the general prevailing opinion that the existing international treaty between the Dominion of Canada and the United States entitled him to conduct such operations, under the existing conditions, without being subject to the restrictions of any of the Canadian labor or customs laws. The act proclaimed by the Dominion of Canada on which Mr. Moran based his belief is worded as follows:—

"1. United States vessels and wrecking appliances may salve any property wrecked and may render aid and assistance to any vessels wrecked, disabled or in distress, in the waters of Canada contiguous to the United States."

"2. Aid and assistance include all necessary towing incident thereto."

"3. Nothing in the customs or coasting laws of Canada shall restrict the salving operations on such vessels or wrecking appliances."

Mr. Moran proceeded with a suitable wrecking outfit to the scene of the wreck in the latter part of April. It appears that interested parties in British Columbia, learning of the proposed salving operations, suggested to the Canadian customs authorities that the waters

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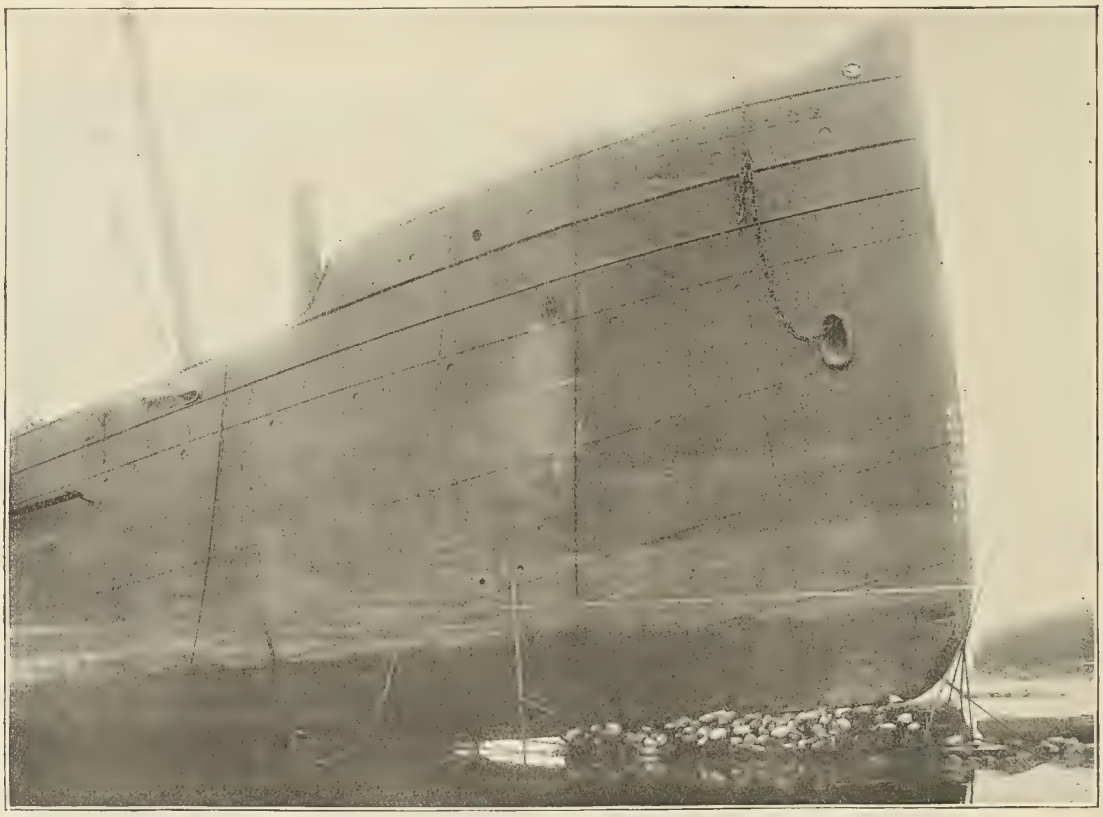
in which the wreck occurred are not waters "contiguous" to the United States, the waters of Union Bay not being bounded directly by United States territory. Acting on the lines of such suggestions, the Canadian customs officers promptly seized the wrecking outfit upon its arrival on the scene of the wreck, and forbade all operations, pending a decision on the subject by the Canadian government. The men constituting the wrecking crew organized in Seattle by Mr. Moran were arrested under the restrictions of the Canadian labor laws. A favorable decision was eventually rendered by the Canadian government, authorizing the work to proceed. (Although the fact that the waters of Union Bay are not contiguous waters to the United States was well established). Pending such decision, however, the wrecking crew was losing much valuable time, as the action of the tides and the weather were constantly increasing the damage to the wrecked vessel.

Immediately upon the release of the wrecking outfit and crew, salving operations were commenced in earnest. The two halves of the vessel were attached and brought together by a number of fore and aft bolts passed through sockets riveted to the hull, the purpose of the bolts being to close the gap between the two halves. The manner in which these bolts and sockets were attached is shown in one of the accompanying photographs. The two halves of the broken hull were duly brought together, and after taking out a large proportion of the cargo, the after hold was pumped out preparatory to floating the vessel off to a sandy beach near by, it being Mr. Moran's intention to beach the vessel on an evenly sloping shore and complete the desired repairs at low tide.

At this critical point, the boiler makers forming part of the wrecking crew, hearing that their brother workmen in Seattle had gone out on the general strike affecting the entire United States, decided that they could not work under existing conditions, and disregarding Mr. Moran's urgent need of their services, immediately left his employ. But Mr. Moran proceeded with renewed energy, and with the aid of his remaining men performed the task which had been undertaken.

The vessel was floated and beached as intended, and permanent repairs were at once commenced. Without the help of trained boiler makers the remaining crew, under the guidance of Mr. Moran, proceeded to plate the vessel over the break in the hull. These repairs were carried as low down as practicable, but could not be extended to the keel. This of course left an element of weakness in the structure, by reason of the keel and keelsons, as well as the bottom plating being entirely torn apart. As the strength at this point could not be provided for without much trouble and delay in building a coffer dam, Mr. Moran concluded to attempt the floating of the vessel without joining the lower part of the structure. In this he failed, for during the operation of pumping out the after hold, the vessel resting on the fore foot, the strength of the hull amidship proved to be insufficient to withstand the stresses thus created, and the plates

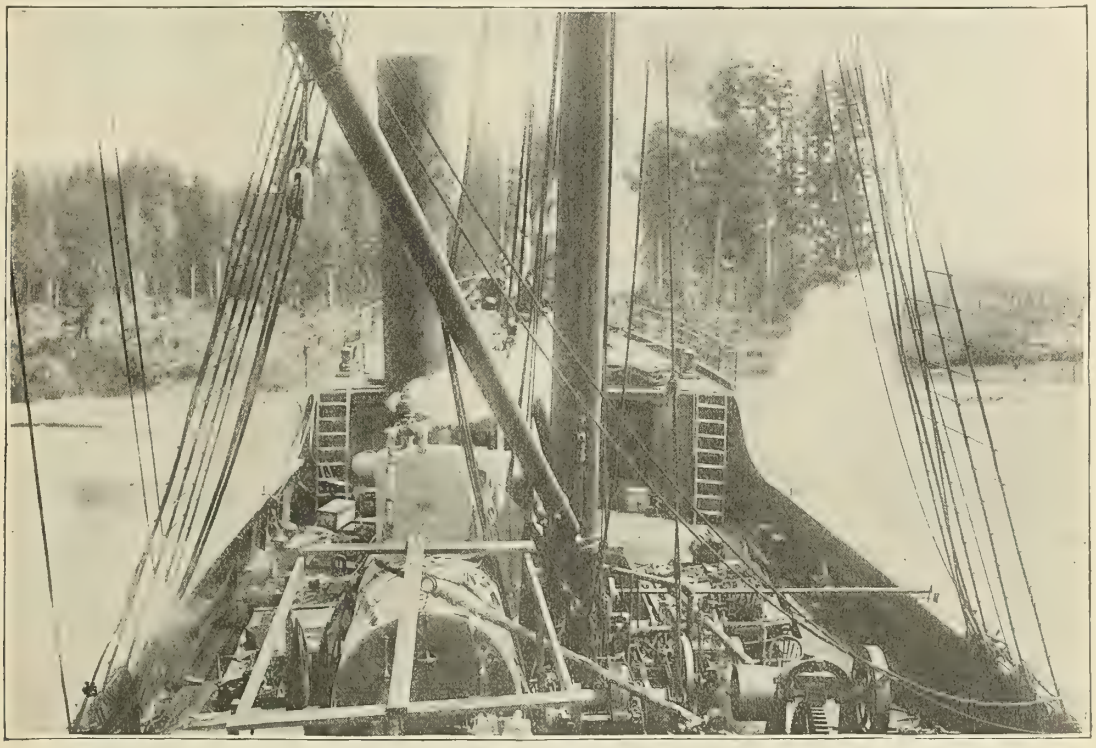


FOOTING BUILT UNDER THE BOW OF THE WILLAMETTE AFTER SHE WENT ASHORE.

and bars, which had been carefully and strongly riveted to the structure on both sides of the break with much patient labor and under extremely adverse circumstances, parted and again left the vessel a total wreck in two parts, as before the operations were begun.

The effect of this failure was very depressing and discouraging to the members of the wrecking crew, but Mr. Moran's untiring energy soon restored confidence, and after devising an entirely new plan of operations, work was again resumed. The two halves were again joined, but instead of attempting to strap them by means of steel plates and bars, Mr. Moran conceived the plan of fitting a timber splice on the outside of the shell. This splice was to consist of a number of heavy and long timbers, bolted outboard to the ship's framing through the shell, one timber over the other from the water line up to the upper deck, each successive layer or strake being edge bolted to the preceding strake, and thoroughly through bolted to the ship's structure. An accompanying photograph well illustrates the manner in which the work was done. No attempt was made to secure water tightness, on account of the open break in the shell below the splice, which of course gave free access of water to the main fireroom. After much hard and tedious labor, working almost incessantly, this crew of a few determined men finally ended the great task undertaken, and the timber splice was complete on both sides of the vessel. Then came the anxious operation of again pumping out the hold to float the vessel on an even keel. In view of the previous experience with the steel splice, it was by no means certain that the timber splice would hold, and many persons predicted failure. Mr. Moran's judgment, however, proved to be correct. The vessel was floated to an even keel, pulled off the beach and anchored in the bay. Some anxiety was felt owing to the fact that outside water had free access to the fireroom, but the adjoining bulkheads were properly braced, and from observation after floating they were found to be almost entirely water tight, which enabled both ends of the ship to be kept dry without much pumping.

Most men would have deemed the task of salving the vessel accomplished at this time, and would have placed her in charge of a reliable tug boat for proper destination. Mr. Moran's early scheme, however, had been not only to salve and float the vessel at the place of the wreck, but to bring her to Seattle under steam with her own machinery. At the time of the wreck the engineering crew of the vessel had the forethought to open the oil tanks in the engine room, allowing the oil to spread over the entire extent of the room as the water entered. This, it will be seen, had the effect of spreading the oil over all exposed parts of the machinery, and with the action of the tide this oil layer kept re-coating the engines. After pumping out the engine room it was found that the main engines only needed a good wiping to be serviceable. It was out of the question to supply steam by means of the main boilers, they being partially under water, so Mr. Moran had a large fire box boiler, borrowed from the plant at Seattle, installed on the upper deck of the vessel during the early part of the operations for the steam supply of the pumps, air compressor, etc. This boiler, together with the ship's donkey boiler, which happened to be located above the water line in the fireroom, were united and con-



AUXILIARY BOILER AND WRECKING MACHINERY ON THE DECK OF THE WILLAMETTE.

nected to the main engines. They were put under steam, the engine was turned and was found to be in first class working condition. The vessel then left the scene of the wreck under her own steam, and proceeded to Seattle, a distance of about 250 miles, arriving without mishap August 11, 1901, having covered the distance with an average speed of six knots per hour. The vessel is to be hauled out on specially constructed marine ways in a short time, thoroughly overhauled and substantially repaired, after which she will be fully as good as new.

The steamship *Willamette* is an iron hull vessel, built at Chester, Pa., by John Roach and Son, in the year 1881. Her principal dimensions are, length, 315 feet 6 inches; breadth, 39 feet 2 inches; depth, 21 feet 8 inches. She originally had compound engines, but was refitted in 1898 with new modern machinery by the Union Iron Works, of San Francisco, Cal. Her present propelling machinery consists of a triple expansion engine with cylinders 24, 36 and 59 inches diameter, and a stroke of 39 inches. The indicated horse power is about 1,500. Steam is supplied by two three-furnace boilers of the Scotch type, 13 feet diameter, 11 feet 6 inches long, operated at 170 pounds pressure under Howden forced draught.

Strange to say, the main engine at present in the vessel, although of modern design and perfect in service, has once before been sunk in a wrecked vessel. This was the new steamship *Crown of England*, wrecked on Santa Rosa Island, off the coast of California, on her maiden trip a few years ago.

The steamship *Willamette* has met with other mishaps before the above described. She was in collision with the steamer *Premier*, in Puget Sound, near Seattle, on October 8, 1892, her bow cutting the smaller steamer's upper structure almost to the midship line, and sustaining serious damage. She was found on fire at Seattle while taking on a cargo of coal at the Pacific Coast Steamship Co.'s bunkers on April 29, 1900, and was sunk in place in order to quench the flames. She was raised a few days later and resumed her regular service. She was on fire again on August 2d, of the same year, at San Francisco, Cal., sustaining much damage in the forecastle. It is seen that this vessel has had more than her share of bad luck, but by reason of the enterprising spirit of Mr. Moran his company now has the opportunity to restore the vessel to a condition excelling that of the original new vessel, as the hull structure will be made strong in all its weak points, and the machinery, being of the finest type, will be thoroughly overhauled.

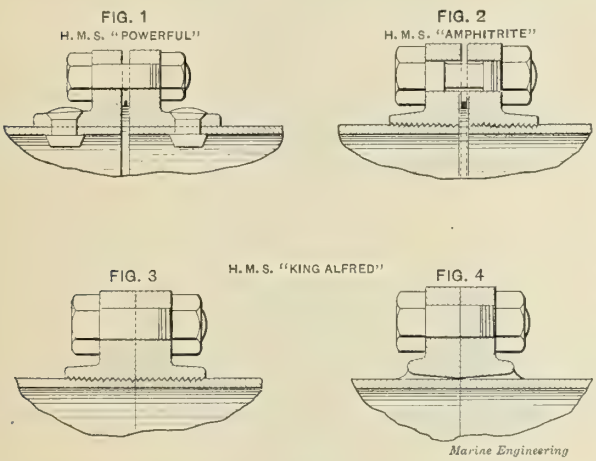
SHOWING MANNER IN WHICH THE TWO PARTS OF HULL WERE FIRST HELD TOGETHER.

Speed of the Battleship Illinois.—The official report of the board appointed to witness the trial trip of the *Illinois* gives the average speed of the ship as 17.449 knots.

Some Difficulties of High Steam Pressures.*

Many difficulties for the marine engineer have arisen during the past few years, owing to the use of continually advancing steam pressures. Especially have these difficulties appeared in connection with the joints for steam and feed pipes, and as they have been overcome in naval ships, they should be made the subject of careful study by those engaged in merchant practice: In the first place, the higher steam pressure has necessitated several changes in the material used. Solid drawn and lap welded steel tubes are now used in place of copper pipes, and for large valve boxes and bends gunmetal is sometimes used; but cast steel would be used wherever possible and more extensively, if castings as thin as considerations of strength would determine could be produced by steel makers. The full use of this material in this country is retarded by the apparent inability to produce sound thin castings.

In the earlier warships, with high steam pressure machinery (260 pounds) all steam pipes over three inches in diameter are of steel. In the later vessels with 300



pounds pressure, the same material is used for all pipes over 1 1-2 inches diameter. Such steel pipes up to 6 inches in diameter are solid drawn with weldless steel flanges screwed on, while those over this size are lap welded with a butt strap covering the weld, the flange being carefully riveted on. It was found possible to bend the steel pipes up to 4 inches, and it is to be hoped that progress will be made in this direction so as to reduce the number of expansion boxes. The higher pressures also involved change in connection with joints; and many experiments have been made. The diagrams illustrate some types as applied in successive cruisers. Fig. 1 shows the steel flanges fitted to the steel steam pipes of H. M. S. *Powerful*. In this example the surfaces are only machine finished, the actual joint being made by a soft copper ring of triangular cross section. This system gave very satisfactory results under water test, but a few months' actual use brought about such pitting of the steel faces, due to galvanic action, that the joints would no longer keep tight. Another objection to the system was the dropping of the ring, owing to its loosening as a consequence of the expansion and contraction of the line of pipe, and its being thus free to take a position eccentric to, and crossing the edges of, the bore. To overcome this the rings shown in Fig. 2 were substituted in H.M.S. *Amphitrite*, in conjunction with a recess formed in each flange, to prevent the ring dropping too far out of place. This effected some improvement, but the trouble from corrosion unavoidable with copper and steel in contact led to the system being discarded in favor of the form shown in Figs. 3 and 4. Fig. 3 shows a steel pipe joint with steel flanges, Fig. 4 a copper pipe joint with brazing metal flanges. Both are finished by hand scraping, and the only material on the joint is a thin wash or paint of red lead and oil. This system has been adopted throughout H.M.S. *King Alfred*, now building at Barrow-in-Furness. The author is of opinion that a simpler, cheaper and efficient form of joint could be used in place of the hand scraped flanges, viz., a joint made with asbestos paper (about the thickness of brown paper) soaked in oil, the faces of the flanges being only machined, with no scraping. Indeed this material was adopted in several instances in the feed discharge pipes in which the pressure is over 600 pounds per square inch, the joints requiring to be remade at sea.

*Abstract from a paper on the Review of Marine Engineering During the Last Ten Years, read by James McKechnie before the Ins itution of Mechanical Engineers.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 142 vessels of 32,310 gross tons were built in the United States and officially numbered during the month of August 1901.

American Shipyards.—In the report of a German shipbuilder, appointed by the German Admiralty to investigate European and American shipyards, he says that the yards of the United States need acknowledge no masters, that "they are incomparably equipped for thorough, rapid and economical production, due primarily to the splendid transportation arrangements in the yard areas and the employment of the most improved type of crane and of pneumatic tools."

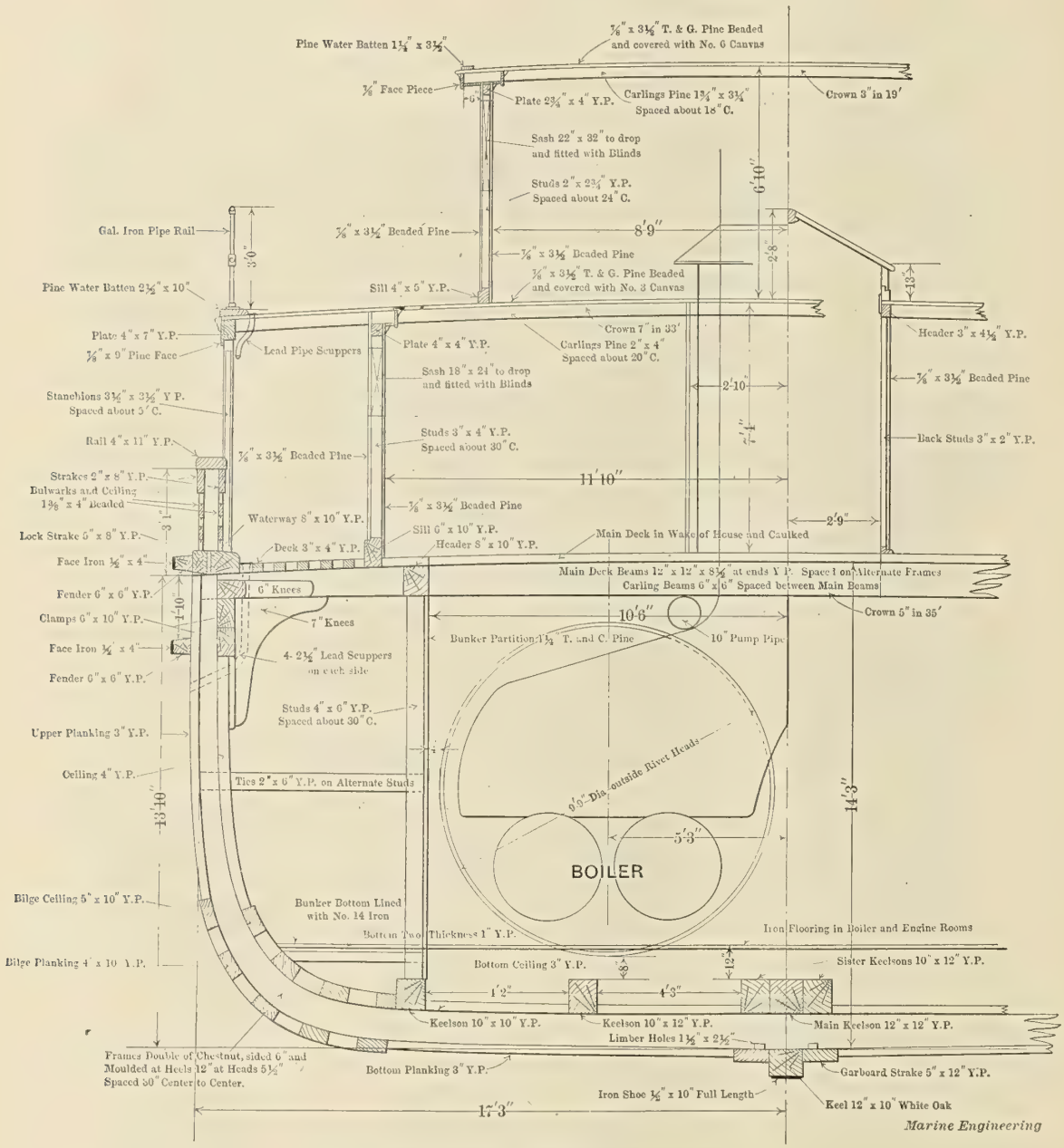
Steamer Lengthened.—The steamer *Iroquois* was recently lengthened 48 feet in the drydock at John N. Robins & Co., Erie Basin, Brooklyn. A cradle and ways were built under the ship forward of the boiler room bulkhead, and the ship cut in two near this point by driving out the rivets and sawing through all joinery and wood. Chains well secured to the vessel were led through the hawse pipes to eight fold blocks. The inshore blocks were fastened to chains which were well anchored at the head of the dock, and the ropes led to two windlasses on shore. There were also two windlasses at the bottom of the dock for pulling the lower part of the ship. Blocks and falls led from these windlasses to plates bolted to the ship's bottom. When all was in readiness the four windlasses were started and the forward part of the ship was drawn to its exact place. The frames, floors, beams, plating, etc., which had been previously made to template were then put in place and the work completed within twenty-one days from the time of docking. The *Iroquois* was built at the Cramp yard in 1888, and her dimensions are: Length, 280 feet; beam, 46 feet; depth, 28 feet 6 inches; tonnage, 2,944 tons. The added length will give her cargo space for 2,000 more bales of cotton.

SUCTION DREDGE FOR HARBOR AT SABINE PASS.

Under date of December 28, 1899, proposals were opened at the United States Engineer's Office, New Orleans, La., for building a seagoing, twin screw suction dredge to be used for improving the harbor at Sabine Pass, Texas, and the contract was awarded

Length over all	145 ft.
Length between perpendiculars	137 "
Beam extreme	35 "
Depth from top of floor to top of beam	12 "
Light draft	9 "
Load draft, with 350 cu. yds. of sand	11 ft. 6 in.
Corresponding load displacement, about	1000 tons
Speed at 11 feet draft	8.75 knots

The keel is of white oak 10 by 12 inches with a 1-2 inch iron shoe the full length. The center keelson 12


Pine Water Batten 1¼" x 3½"
⅞" x 3½" T. & G. Pine Beaded and covered with No. 6 Canvas
⅛" Face Piece
Plate 2¾" x 4" Y.P.
Carlings Pine 1¾" x 3¼" Spaced about 18" C.
Crown 3" in 19'
Sash 22" x 32" to drop and fitted with Blinds
Studs 2" x 2¾" Y.P. Spaced about 24" C.
6'10"
Gal. Iron Pipe Rail
⅞" x 3½" Beaded Pine
8'9"
⅞" x 3½" Beaded Pine
⅞" x 3½" T. & G. Pine Beaded and covered with No. 3 Canvas
Pine Water Batten 2½" x 10"
Sill 4" x 5" Y.P.
Plate 4" x 7" Y.P.
⅞" x 9" Pine Face
Lead Pipe Scuppers
Plate 4" x 4" Y.P.
Crown 7" in 33'
Carlings Pine 2" x 4" Spaced about 20" C.
Header 3" x 4½" Y.P.
Sash 18" x 24" to drop and fitted with Blinds
2'10"
⅞" x 3½" Beaded Pine
Stanchions 3½" x 3½" Y.P. Spaced about 5' C.
Rail 4" x 11" Y.P.
Studs 3" x 4" Y.P. Spaced about 30" C.
Back Studs 3" x 2" Y.P.
⅞" x 3½" Beaded Pine
Strakes 2" x 8" Y.P.
Bulwarks and Ceiling 1⅜" x 4" Beaded
11'10"
Waterway 8" x 10" Y.P.
⅞" x 3½" Beaded Pine
Lock Strake 5" x 8" Y.P.
Sill 6" x 10" Y.P.
Header 8" x 10" Y.P.
2'9"
Deck 3" x 4" Y.P.
Main Deck in Wake of House and Caulked
Face Iron ½" x 4"
Main Deck Beams 12" x 12" x 8⅜" at ends Y.P. Spaced on Alternate Frames
Carling Beams 6" x 6" Spaced between Main Beams
Fender 6" x 6" Y.P.
6" Knees
Crown 5" in 35'
Clamps 6" x 10" Y.P.
7" Knees
10'6"
Face Iron ¼" x 4"
Bunker Partition 1½ T. and C. Pine
10" Pump Pipe
4- 2½" Lead Scuppers on each side
Fender 6" x 6" Y.P.
Studs 4" x 6" Y.P. Spaced about 30" C.
Upper Planking 3" Y.P.
0'0" Dia. outside Rivet Heads
Ceiling 4" Y.P.
Ties 2" x 6" Y.P. on Alternate Studs
5'3"
BOILER
Bilge Ceiling 5" x 10" Y.P.
Bunker Bottom Lined with No. 14 Iron
Iron Flooring in Boiler and Engine Rooms
Bottom Two Thickness 1" Y.P.
Bilge Planking 4" x 10" Y.P.
Bottom Ceiling 3" Y.P.
Sister Keelsons 10" x 12" Y.P.
1'2"
4'3"
Keelson 10" x 10" Y.P.
Keelson 10" x 12" Y.P.
Main Keelson 12" x 12" Y.P.
Limber Holes 1½" x 2½"
Frames Double of Chestnut, sided 6" and Moulded at Heels 12" at Heads 5½" Spaced 30" Center to Center.
Bottom Planking 3" Y.P.
Garboard Strake 5" x 12" Y.P.
Iron Shoe ½" x 10" Full Length
Keel 12" x 10" White Oak
17'3"
Marine Engineering

MIDSHIP SECTION OF SUCTION DREDGE.

to the Townsend and Downey Shipbuilding and Repair Company. This company built the hull and propelling machinery complete and delivered the steamer to the Government in March, 1901.

The hull and joinery of this dredge are of wood throughout, and the principal dimensions are as follows :—

by 12 inches, the sister keelson 10 by 12 inches and the side keelson 10 by 12 inches are of Georgia pine, the material used throughout where not otherwise specified. The frames are of chestnut, doubled, each course to be sided 6 inches and moulded 12 inches at the center with suitable lap for floors, and spaced 30 inches centers. The knees are of hackmatack. The

ceilings between the clamp and bilge streaks are 4 inches, and the flooring 3 inches thick. The clamps are 6 by 10 inches, four on each side. The outside planks are 4 by 10 inches and the remainder 3 by 10 inches. The hood ends are of oak.

The main deck beams are 12 inches sided by 12 inches moulded at center and 8 1-2 inches moulded at ends, with a crown of 5 1-2 inches on longest beam. Beams are to be alternated with one 6 by 6 inch carling set between them.

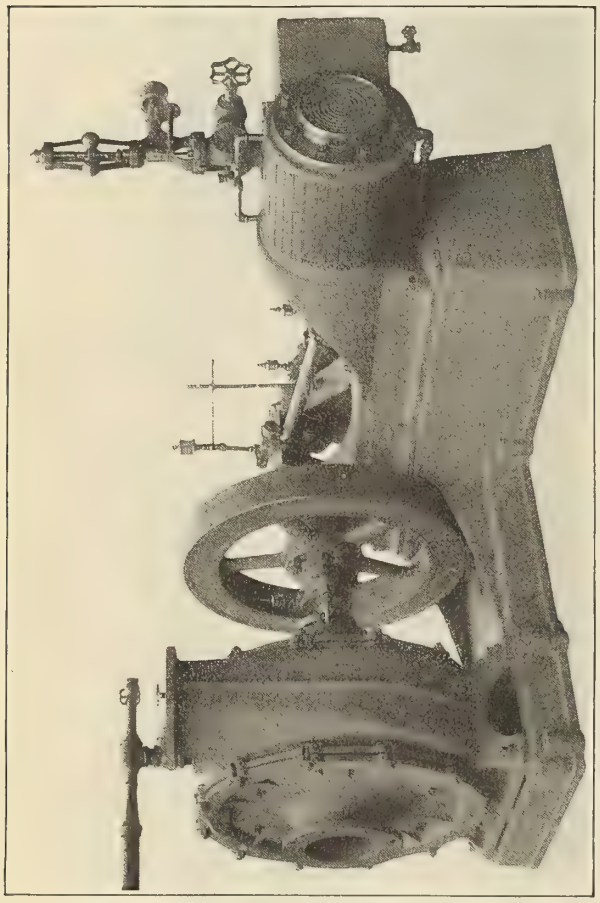
FRAMING AT STERN.

FRAMING AT BOW OF SUCTION DREDGE.

The vessel is divided into seven compartments by six bulkheads, two of which are water tight. In the forward compartment, where a lower deck is worked in, is the forecastle with a chain locker at forward end.

The second is used for stores. The third contains a large sand bin, the two boilers and wing coal bunkers, and its forward bulkhead is water tight. In the fourth compartment is placed the dredging machinery mounted on a deck 6 feet above the base line. The fifth compartment contains the propelling machinery and after sand bin, and the sixth is fitted up for the crew. Between these two compartments is a water tight bulkhead.

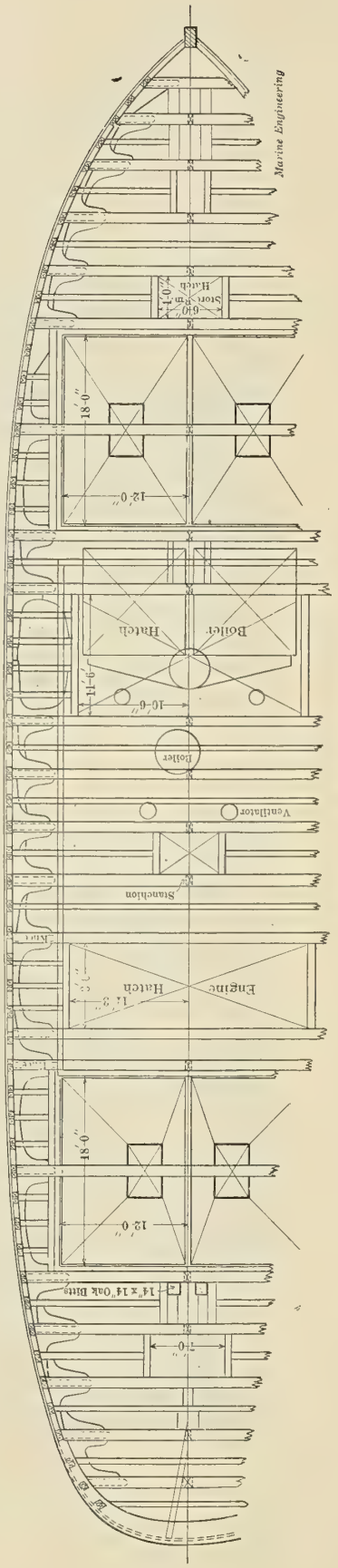
The wooden deck house extends from the forward end of the after bin to the after end of the forward bin, and in it are the galley, pantry, mess room, petty officers' quarters, bathroom and cold storage. A shade deck extends from side to side from the foremast 80 feet aft. On this deck are the pilot house with



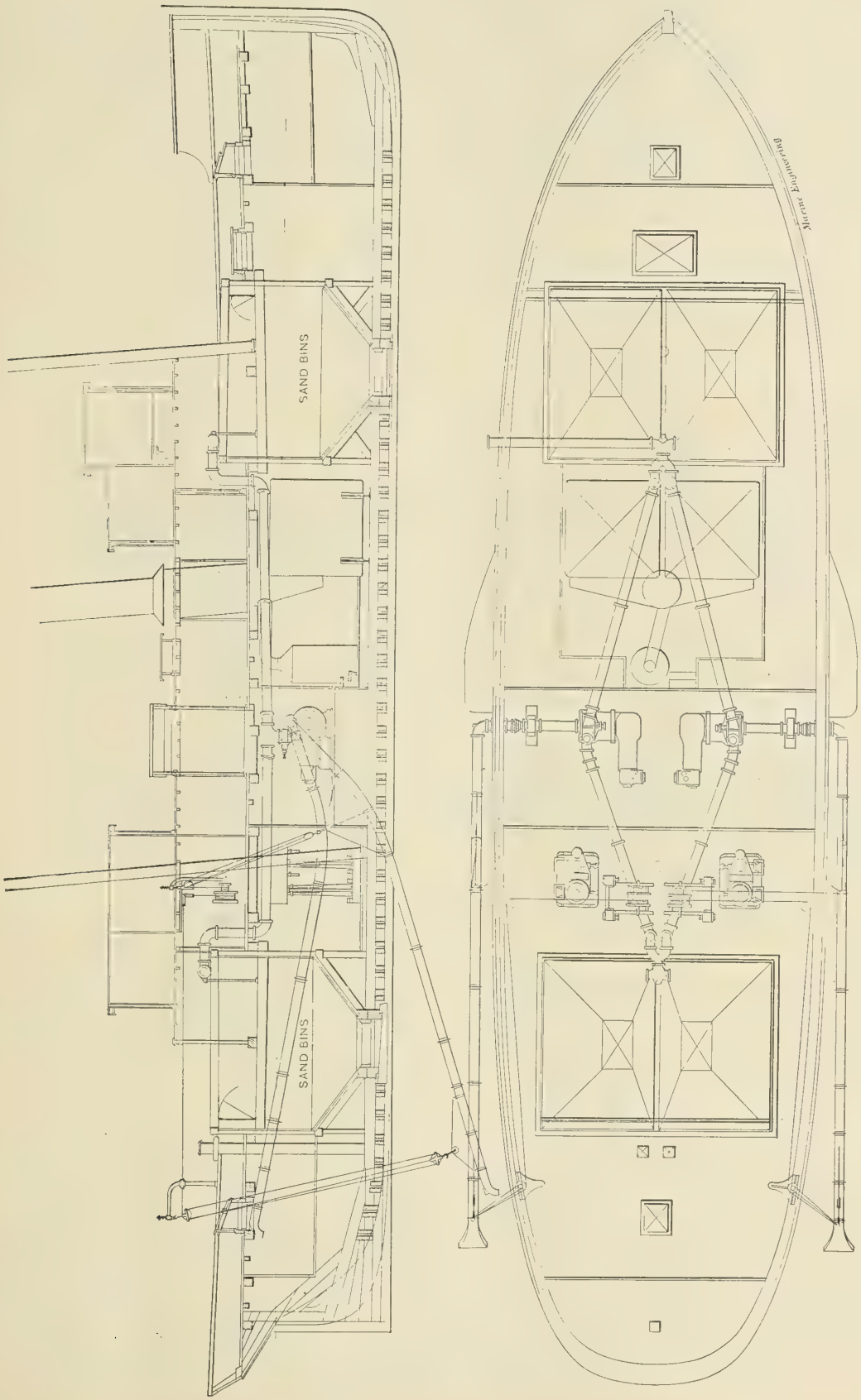
CENTRIFUGAL PUMP FOR SUCTION DREDGING.

rooms adjoining for the captain and engineer in charge, and the officers' quarters located over the engine room.

The propelling machinery consists of two sets of compound condensing direct acting engines with cylinders 13 1-2 and 27 inches in diameter by 20 inches stroke. Each set of cylinders is supported by two round columns on the inboard sides and two cast iron box housings on the outboard sides bolted to cast iron bed plates. Stephenson link motion actuates a piston valve on the high pressure and a slide valve on the low pressure cylinder. The shafts are 6 1-2 inches diameter fitted with bronze sleeves at stern bearings, and the propellers are 7 feet diameter by 8 feet 6 inches pitch, of cast iron with four blades. The independent



DECK PLAN OF SUCTION DREDGE.

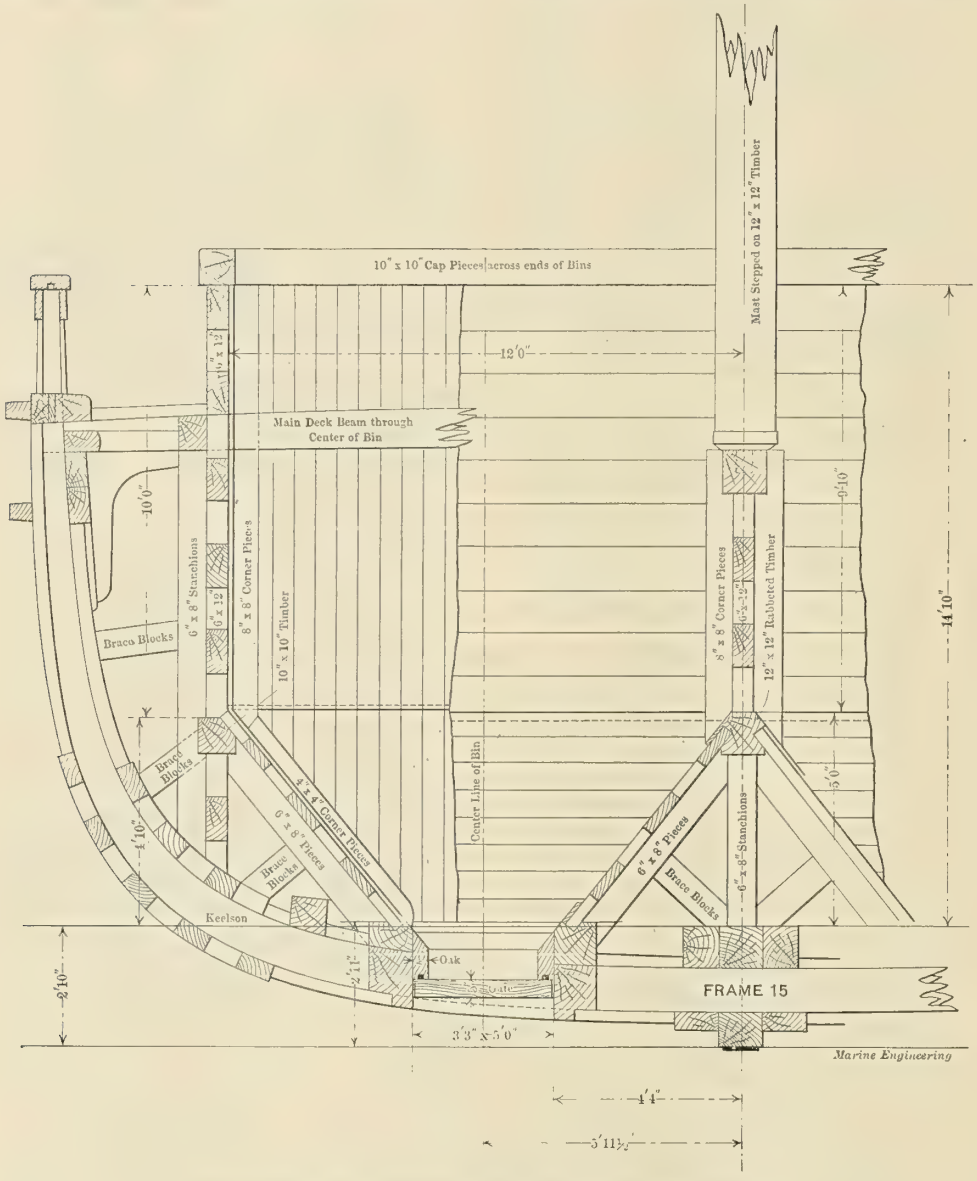


ELEVATION AND DECK PLAN, SHOWING GENERAL ARRANGEMENT OF DREDGING MACHINERY ON SUCTION DREDGE.

condenser has sufficient cooling surface for condensing the steam from all machinery running at one time and at full speed except the propelling engines, which will then run at three-fourths power. There is the usual equipment of pumps for air, circulating, feed, bilge and fire purposes.

There are two Scotch boilers 9 feet 6 inches diameter and 10 feet long, built for a working pressure of 125 pounds per square inch. The shells and heads are of 5-8 inch plates. Each boiler is fitted with two corrugated furnaces 7 feet 7 1-2 inches long and 3 feet 2 inches outside diameter, leading into a common combustion chamber. The dimensions of one boiler are as follows: Number of tubes, 130; size of tubes, 3 inches; heating surface in furnaces, 69.7 square feet; in combustion chambers, 87.4; in tubes, 714.6; total, 872 square feet; grate surface, 34 square feet; area through tubes, 5.48 square feet. The donkey boiler is 4 feet diameter and 7 feet high.

The dredging plant built by the Joseph Edwards Company consists of two independent 10 inch centrifugal pumps with runners 33 inches in diameter, and each direct connected to a single horizontal engine 12 by 11 1-2 inches. When running at 300 revolutions with the suction heads digging in a depth of 30 feet of water, these engines each indicate about forty horse power. A 10 inch cast iron suction pipe leads from the pump through swivel side pipes with double stuffing boxes to a 6 foot length of 10 inch corrugated suction hose. At the other end of hose are five lengths of 10 inch steel pipes and a suction drag with detachable mouth piece, making a total length of suction pipe from the mouth of swivel joint of about 48 feet. Each line of pipe has a side bridle sling at upper and lower end, with lines leading to a double drum, double cylinder 5 1-2 by 7 1-2 inch hoisting engine, geared to ratio of 1.: 4. The flow of water and sand is discharged through swing gate and steel and cast iron pipes to

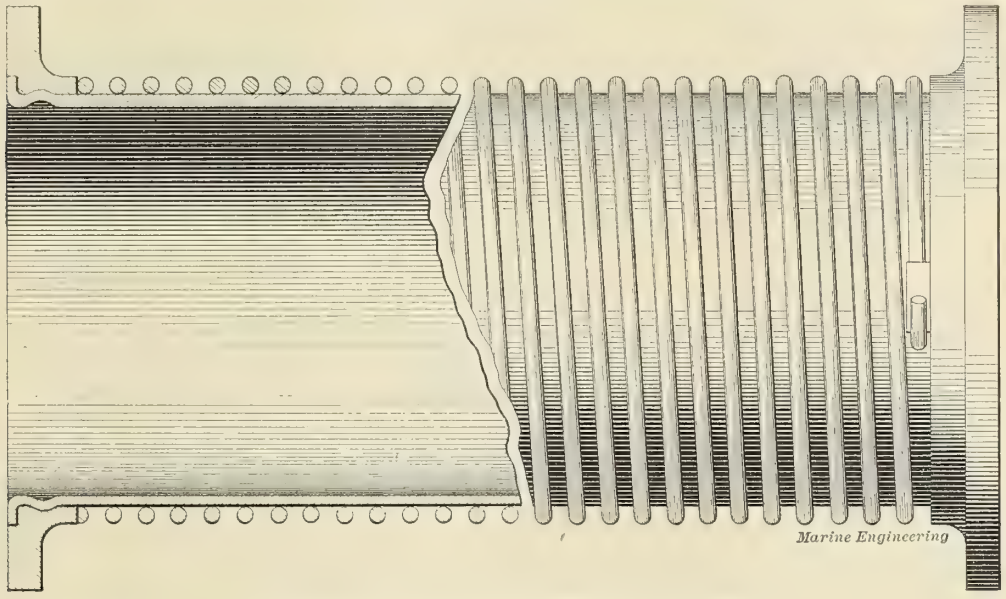


SECTION OF FORWARD PORT SAND BIN ON SUCTION DREDGE.

either the forward or after sand bins or to both bins. Also by means of swinging gates on the discharge pipes at the bins, the output can be directed into either the port or starboard bins or both.

The construction of the forward port sand bin is shown on page 414, and the other three are practically the same. They are fitted with adjustable steel weirs for regulating the filling of the sand bins to different heights. The gates at the bottom are operated by vertical rods fitted with hand wheels and double train of gears.

This staunch little dredge is expected to work in the open sea during moderate weather and dig out the channel by steaming slowly back and forth over the course with the pumps going and the suction heads trailing on the bottom from both sides of the vessel. When the bins are full the suction pipes are raised and the steamer proceeds out to sea to discharge the load.



THE IDEAL WIRE WOUND COPPER STEAM PIPE.

COPPER STEAM PIPES.

BY GEO. C. STANLEY.

Regarding the numerous articles published in the various engineering journals, in opposition to the employment of sheet copper in the construction of steam pipes for high pressures, and the need of some material which will possess its maleability and general working qualities, and with a greater tensile strength, and without the liability to loss of strength due to so-called burning in the operation of brazing, let me say in defense of the copper steam pipe, and in extenuation of the "Alexander's who have wrought much evil" that the frequent bursting of these pipes is not so much due to the effects of brazing as to the results of defective arrangement. Designers, possessing the knowledge that coppersmiths can work sheet copper or tubes into every conceivable shape, make their general arrangement of steam pipes accordingly, and often, for the economy of space, they are fitted into undesirable shapes and places regardless of their expansion or contraction, or the vibrations they may receive from a high-speed engine.

In making the general arrangement of steam pipes for a vessel, they should be so designed that their structure will not be subjected to strains beyond the limits of their elasticity, and their weight should be so carried by hangers as to give them a freedom of movement in expanding and contracting. It is a well-known fact to metallurgists, that when a metal is repeatedly carried beyond the limits of its elasticity, permanent sets will occur, which makes the metal extremely hard and brittle, and when this takes place in a steam pipe, and the limit of resistance is reached, it flies asunder with great violence. As all metals change their molecular structure in time from the continuous application of forces, and under variable temperatures, the copper steam pipes of vessels should be carefully examined for defects, by those who understand the nature of this metal, and those parts which show a tendency to crystallize should be annealed, in order to restore them to their normal condition.

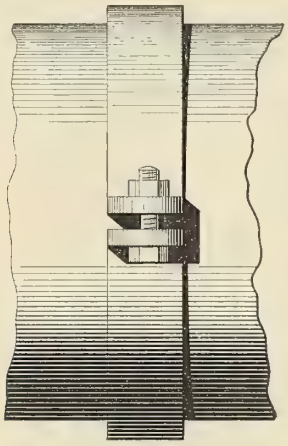
The general rule in making the annual inspection of steam vessels is to subject the boilers and fittings to a hydraulic test. As regards the main steam pipe, this method of inspection only proves that the pipe is tight and will stand the hydraulic pressure at the temperature of the water used. A pipe may be as hard and brittle as glass and have many defects which will not show from a hydraulic test. The only way to examine a copper steam pipe for defects is to remove its clothing and carefully scrutinize its surface for permanent sets, which are shown by waves or ripples on the surface. These waves demonstrate that the pipe not returning to its usual form, has gone beyond the elastic limit, and a permanent set has occurred; from these sets the metal has become crystallized, and will not yield to pressure until the limit of resistance is reached.

In the endeavor to make the best out of the material at the disposal of builders of steam vessels, copper

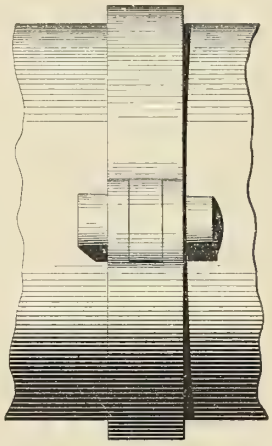
steam pipes for high pressures have been banded at intervals with hoops of steel, and secured by means of bolts and keys, as shown in the annexed sketches. From a careful inspection of pipes so treated, after a service of one year, these bands were found to be loose upon the pipe, and the points where they had contact with the pipe when first secured were considerably compressed with a well-defined scar around the pipe from the sharp corners of the bands. This injury may be attributed to the difference of expansion of the two metals, or from the rigidity of these points in the pipe, while in the act of changing its form, from expansion or excessive vibrations.

To meet the requirements of higher pressures, and to retain those qualities which brought copper into general use for this purpose, there is submitted in the annexed diagram, from a coppersmith's point of view, an ideal copper steam pipe. Its thickness is computed on the assumption that the tensile strength of copper is 30,000 pounds to the square inch. Its lap of seam is two and one-half times the thickness of the metal. The flanges are recessed in the bore and on the face, and are secured by expanding the pipe into the recesses, and uniting them by the electro deposition of copper in the interstices. The pipe is then wound taut with unannealed copper wire possessing a tensile strength of 60,000 pounds per square inch, and of the same gauge as the pipe, with the ends secured to the lugs on the collar of flange.

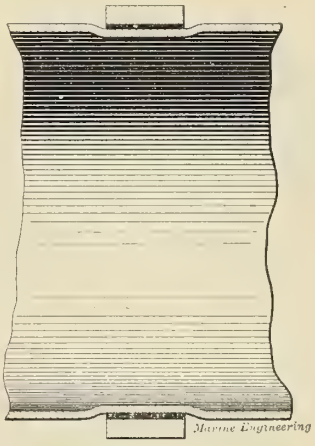
The advantages claimed for this method of construction are that from the short lap given in comparison to the general practice, the liability to burning or washing down in the operation of brazing is reduced to a minimum. By uniting the flange to the pipe by the electro deposition of copper, the pipe is reinforced at a critical point, the junction of thick and thin material, thus dispensing at this point with the usual circular ring of brazing solder, which is of a crystalline character. The flanges not having to stand the temperature required in brazing, can be made of a stiffer composition, which will not buckle or warp in the operation of making the joints, thus reducing the liability to leaks at these points to the lowest degree. By securing the binding wire to the lugs as shown in the sketch, the body of the pipe is given a freedom of movement which will be sentitive to every vibration or change of shape, and allow the pipe to recover its form without compressing its diameter or taking permanent sets. As this system of banding possesses the same expansive qualities as the pipe, and with a greater tensile strength, a uniform grip upon the surface of the pipe is maintained under all conditions, and compensation is given for the depreciation in the value of tensile stregth of the pipe, due to the high temperature of the steam.



BOLT BAND.



KEY BAND.



COMPRESSION WITH LOOSE BAND.

A SIMPLE METHOD OF PREVENTING CORROSION OF TAIL SHAFTS.*

BY JAMES M. THORNTON.

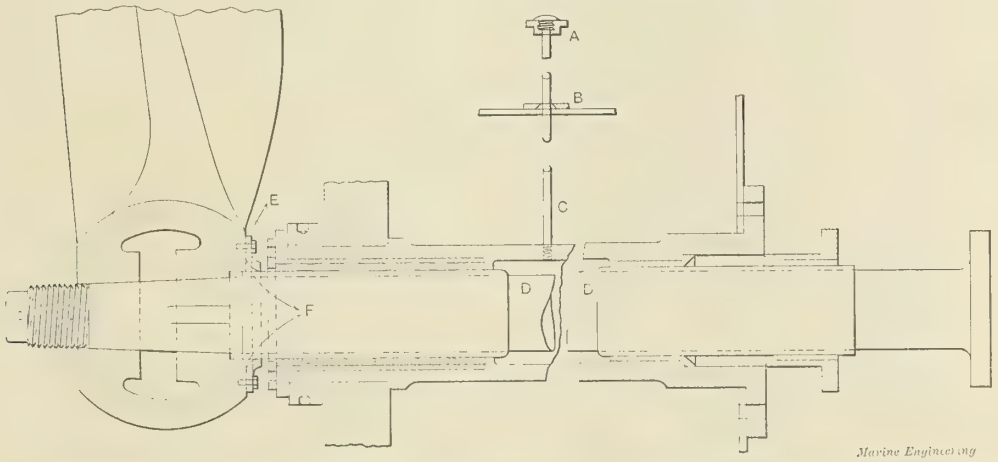
The object of this short paper is simply to put before the members the result of some years' experience on the protection of tail shafts from corrosion, and to prove that tail shafts can be preserved and made to last for years without breaking.

The sectional drawing will show the method which the writer has adopted for some years with special satisfaction.

A is a small deck cap and flange on cabin floor, to which is connected an inch galvanized pipe C leading through the after peak tank top B and screwed into the stern tube at D. The pipe C should be securely stayed in after peak, and a flange with a conical hole in should be bolted on tank top at B with a little packing, so as to form a simple gland and allow for vibration of pipe when in heavy weather. At any convenient place between the tank top and cabin floor, the pipe should be an inch open, and coupled up with a short piece of India rubber tube, so as to allow the deck to vibrate without the danger of breaking the pipe. The stern tube is then filled through pipe C, with a mixture of common oil, tallow and white lead, all boiled together and put in hot. Care should be taken not to put too much tallow into the mixture or it will "set" in the tube and simply form a shell of tallow (fast to tube) in which the shaft will revolve. When mixing this, a ladleful should be taken out of the kettle or pot in which it is boiled and immersed in cold water, so as to get it of the right substance when in cold water. It

* Paper read before the Northeast Coast Institution of Engineers and Shipbuilders.

should be of the same substance as soft soap (when in cold water so that it will run freely into the whole empty space in stern tube, and into grooves between lignum vitae. Whilst pouring mixture into tube, a little cold tallow should be plastered round liner at outer end of stern tube, to prevent leakage until ship is afloat, taking care to leave a small air vent hole at the upper side. The screwed cap should then be put into deck flange. The stern gland should be screwed up tight, so that when engines are working no oil mixture or water will pass through. It is practically impossible to screw this gland up dangerously tight, as if this is done to such an extent as to heat the gland and shaft, the result is only to melt some of the mixture, which will ooze through and keep the parts from seizing. In such a case the gland should be slacked back a little, and when once adjusted will run for months without alteration, and without allowing any water to pass through the stern gland. It is obvious that so long as nothing passes through the stern gland, the water pressure on the outside tends to force and keep the oil mixture in the stern tube, and the cap on pipe at deck being fitted air tight leaves a certain amount of space in pipe which tends to prevent the mixture leaving the lower part of pipe.



METHOD OF FITTING TAIL SHAFT FOR RUNNING IN OIL AND TALLOW TO PREVENT CORROSION.

After the stern tube is once thoroughly filled in dry dock, it has been the practice of the writer to put about half a gallon of cheap oil and a little white lead down the pipe, say, about once every month or six weeks when vessel is afloat.

The next point the writer will briefly remark upon is the outer end of the after liner. It is agreed that all brass liners should enter a recess in propeller boss, and the space between liner end and bottom of recess filled with suitable jointing material. If this work is done very carefully it generally preserves the shaft there, but the result of the experience of the writer is that "when the work is done at night time (which is frequently the case), unless the person specially interested in the life of the shaft is there to see it fitted properly, and the space in recess properly jointed, so as to be water tight," there is a chance of water getting into the recess, which of course results in the corrosion of shaft. To thoroughly ensure getting this part kept free from water, the writer has fitted a conical brass flange (shown at E on drawing). This flange is bored out conical, so as to thoroughly compress the marline lapping at F. The flange is securely bolted to propeller boss and jointed with red lead. Brass bolts are fitted, and the flange made in halves, so that it can be removed when the propeller is required to be taken off. When ordinary care is exercised, the writer has never known this system to fail preserving tail shafts for years, and friends of his can also testify to its merits in keeping new tail shafts as bright as silver (all over), after having been in the tube over three or four years. The writer has at present several steamers (large and small) to superintend, and it is a fact that the tail shafts, when drawn for examination, are in exactly the same condition as when last seen, and in some cases, where new shafts were fitted a few years ago, they are practically as bright today as when they left the lathe. This method ensures the lignum-vitae bearing lasting much longer, as some of the vessels so fitted have only worn down 3-16 inch in three and four years, which shows the lubricating of the shaft to be an advantage. The importance of this is obvious, as the bending strain (in addition to torsion strain) must become more and more severe as the shaft wears down, and if the slightest corrosion exists at the end of one of the liners the shaft is very unsafe. The experience of the writer includes supervision of vessels fitted with tail shafts having no brass liners, and simply running on cast iron bushes, and also of short stern tubes and one continuous liner on shaft, but the object of this short paper is to place before the members the result of some years' working of the foregoing simple method of preserving tail shafts from corrosion, and breakage, where shafts are fitted with ordinary brass liners.

Ramsey Shipyard.—By the incorporation of the Standard Shipbuilding Company, of Perth Amboy, N. J., it is expected that the plant formerly owned and run by Mr. Hugh Ramsey, will be put in active service. The capitalization is $200,000, and the shares are held by members of the Ramsey family.

THE STERN WHEEL STEAMBOAT JOSEPH B. WILLIAMS TOWING A FLEET OF BARGES, CONTAINING 1,453,000 BUSHELS OF COAL.

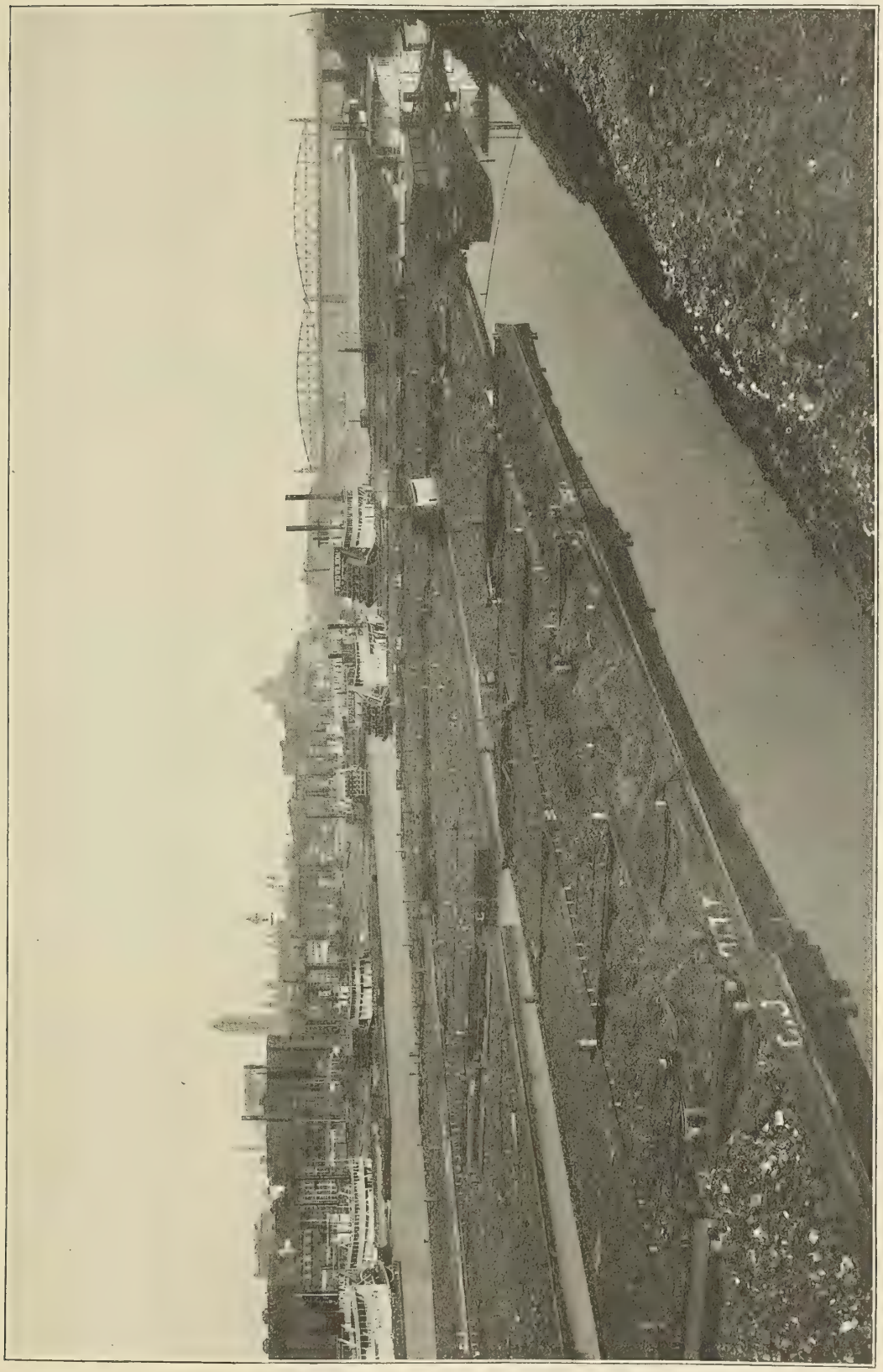
THE OHIO RIVER COAL FLEETS.

BY H. C. FITHIAN.

One of the most important as well as interesting features of the Ohio River Marine Engineering is its coal trade and the method of moving such vast quantities of that necessary article, rightly called "black diamond." Better far could we do without the dazzling beauty than its black and grimy relative, the loss of which to the world would result in untold misery and the possible disintegration of our whole system of mechanical, commercial and social life.

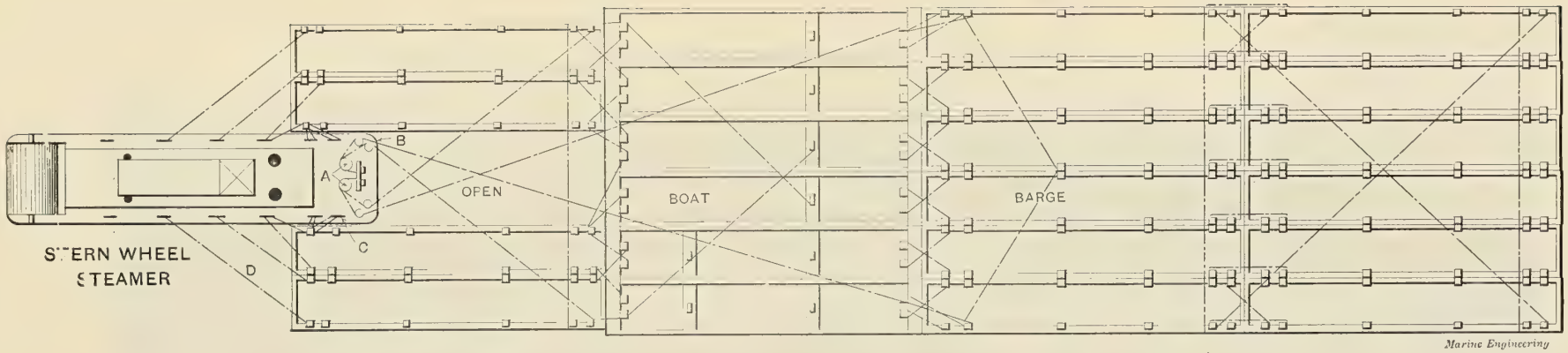
The Ohio River is the highway by which the coal of the western slope of the Allegheny Mountains is distributed throughout the West and South. The magnitude of this industry is but little understood by the majority of people. In the present article we shall dwell more upon the method of handling than the quantities handled.

There are two classes of boats used in the transportation of coal; to use the "river man's" term, one is styled the "coal boat," and the other "the barge." The former are about 170 feet long over all, 28 feet beam and 8 1-2 feet deep at the gunwales, and will contain an average of 25,000 bushels each. They are built entirely different from the barge, and of considerably lighter stuff, although they carry a greater bulk. Below the water line they are made of 1 1-2 inch stuff, while from the top to the water line a strip called the "drift streak" is worked of about 3 inches thickness. They are fitted with what are called check posts, as shown in the sketch in the second tier ahead of the steamer. These are either five or six in number, as the case may be; there are two in each end, and either one or two about one-fourth to one-third the length of the boat from either end. These posts are round and made from tree trunks from 18 to 24 inches in diameter. They are set away from the sides and ends of the boat and heavily braced with sapling wood from 3½ to 4 inches diameter. These braces are placed at right angles to one another, and are often used without removing the bark. While all such are called check posts, those that are one-fourth to one-third the length from the ends are especially designated the swing posts. They are made in this way so that in case of a heavy strain on the timber from either wind or wave enough to break an ordinary timber, the post would pull out of the boat, doing it no damage; whereas a similar strain on a timber head, as described later, would pull the whole side out of the barge. The barges are about 135 feet long, 26 feet beam and 8 feet deep, drawing 6 to 6½ feet, carrying from 14,000 to 18,000 bushels each, according to the stage of the water, which at some seasons is so low that the movement of coal is tied up at Pittsburg and other points. These have what are called timber heads, as shown in the first, third and fourth tier of the sketch. The barge is about 7 inches thick on the sides and 2½ inches on the bottom. The timber heads are placed as shown, two on either side close together near the ends, and two single heads on each side one-fourth the length of the boat from the ends. They are placed flush with the sides of the barge, and hence it can be seen why the barge, though smaller, is made of heavier stuff that the coal boat. The timber heads under a heavy strain would be apt to break the sides out of a barge, where the check posts would pull out without damage. The objection to the check post is the inconvenience in unloading, for, being in the center between the sides, they are always in the way. The sizes given are approximate, but are a fair average of all, the difference being slight. The towing boats or steamers usually handle from 12 to 16 pieces, as the coal boats and barges are called. This would average 14 in each fleet, but they vary somewhat in number, according to the stage of the river. This would mean about 350,000 bushels to the tow or fleet, and as there are about 125 towboats engaged in the business, about three-fourths of this number being classed as large boats, the total amount of a coal "run" would amount to many million bushels. The writer is informed that the largest single tow on record leaving Pittsburg was brought down by the steamboat *Joe B. Williams*, in the spring of 1900, with thirty pieces, ten more being picked up at Cincinnati for Louisville. The largest single run of coal was made in the fall of the same year, when about sixty steamboats came out with some 17,000,000 bushels. The barges are especialy adapted to low water, although they are used at all stages. They will run from fourteen to eighteen to the tow, and the average would be about 260,000 bushels. It is quite impossible to separate the barge from the boat runs, as both come out mixed in the tow. The coal boats are all of the check post type and the barges of the timber head. The accompanying diagram shows that an open space of water, com-



THE WATER FRONT AT PITTSBURG, WITH COAL FLEET PREPARING TO DESCEND THE OHIO RIVER.

(Copyright, 19.., by Chautauqua Photographic Co., Pittsburg, Pa.)



FORMATION OF A TOW OF COAL BOATS, SHOWING METHOD OF LASHING THE BARGES TOGETHER.

monly called the pool or duck pond, is left directly at the head of the towing boat. Occasionally this space is partly filled with one or two small craft, but some space is always left for the duck pond. This is done to reduce to the minimum the pressure and friction of the water against the boat and allows the water to flow more easily under it, thereby producing the least amount of resistance.

The four boats or barges directly at the head of the steamer are, with it, the controlling power of the mass in front. Those in the next row or tier, as it is called, are set in so that the two in the middle of the open space shall have a bearing on each side of the boats in the first tier; although in a few instances the steamer is as wide or wider than the two boats in front of the "pond." The rest are set in regular order, fore and aft. In case a "piece" needs to be dropped off out of the front tier the space is left open; but if one is taken from the rear the space is filled. This is done so that the heaviest part is always nearest the steamer. In the smaller tows two boats only are used in the first tier, changing, of course, the general formation of the whole.

The tows or fleets from Pittsburg to Cincinnati run from six to eight abreast, and from Cincinnati to Louisville from six to ten wide, according to the power of the towboat and stage of the water.

The towboats or steamers are of different sizes and powers, but usually a little wider than the width of two boats, but, as stated above, this does not always prevail. When the steamer is wider than two coalboats the lashings of the third tier with the bridle pull rather than push these two with the fleet. The largest steamers have from 1,600 to 1,800 indicated horse power. These steamers are long, narrow stern wheelers, and while some are called large and others small they are all small as compared with the really large passenger packets, although their engine power is relatively much greater. It was the writer's privilege recently to spend an afternoon on *J. B. Finley*, the guest of Capt. W. L. Carroll. The *Finley* is about the largest tow boat in the service, being 11 feet shorter, but 18 inches wider, than the *Williams*.

The tow boats have several cleats or cavils, as they are called, on the sides and on the deck of the forecastle. These cleats are 5 feet 6 inches long by 8 inches square. Between the cavils are horizontal pulleys, termed chocks. Most of the boats have two capstans on the forecastle, as shown at A in the diagram, and two others placed aft of the boilers. The latter are termed stern capstans. The smaller boats have one capstan at the head and one at the stern. The term stern is used, but as a matter of fact they are set about the middle of the boat. The capstans stand about 4 feet high, revolving horizontally, and are worked both by hand leverage and by steam engine. The latter is a small engine, commonly called the "nigger," and separate from the main power. There are two types of capstans; one the double, having two concave grooves so that more than one line can be used. The other type, having only a single groove, is also sometimes used.

The bitt proper is a heavy double cleat made of 12-inch by 12-inch timber, placed forward of the capstans. It is used to hold fast the ends of the lines as they are fed to or from the capstans. The lines of manila rope of 2-inch diameter running back from the tow to the cavils on the sides of the boat are the backing lines, marked D on the sketch, and serve to keep the tow in place.

As shown in the diagram, the first tier, barges in this instance, are set well back of the head of the boat. The two short lines running back from the first cavils on both sides of the boat to the tow are called the tow lines and are the pushers. These have from 6 to 8 feet lead, and are marked C on the sketch. The lines marked B are termed the "bridle." They are of 2-inch manila rope, and from the capstans and bitt extend to the third tier. Every boat and barge in the fleet is fastened to its neighbor, so that the whole mass is moved as a solid body. The diagram

is made to show the different types of boats and barges, and is accurate as far as it goes, but as a matter of fact the fleets are not always made up in exactly this way. The fleets come down the river in all sorts of mixtures of boats and barges, timber heads and check post, lumber, brick and stone boats. There is no set way of fastening, but the river men know how, and are always equal to the occasion, no matter what.

The short lines connecting the several tiers are termed lashings. When of rope they are of 1½ inch manila, and have a spliced loop on one end large enough to go over two timber heads. The loop is thrown over the heads of the barge in front and wrapped around those of the one astern. The lashing is pulled taut by a twister or Spanish windlass. This is nothing more than a strong hickory piece six or eight feet long which, at the knotted end, is run through the open and twisted until the lashing is tight. Sometimes both chain and rope are used. It is seen that the lashings of boats always cross each other, while the barges are lashed straight fore and aft. The cross lines in the fore part of each tier, while not being as heavy as the others, aid in holding the tiers together. They are of 1 1-8 inch wire cable, and are drawn taut by a turn-buckle arrangement operated by a ratchet, which, though comparatively small, has enormous power. All chain and wire cables have a loop at one end and are drawn taut by the ratchet, while the end which has no loop is wrapped around the timber of the boat, to which it is to be attached and bound by a hook and open link. Every chain, wire and rope should be absolutely taut, so that the whole mass maintains its solidity, allowing no play whatever. We are informed, however, that some masters make up their tows allowing some play. It takes from 17 to 20 hours to assemble a fleet, and it is plain that it is hours of hard work.

The timber heads on the quarter side of the barges and check posts in the quarters of the boats are used in casting off a single craft and in emergencies.

The casting off of a piece out of the fleet is an interesting process, which is often done without much checking of the progress of the balance of the fleet, but at bad landings it is necessary to come to an anchorage by shore lines.

In casting off a boat while in motion it is disconnected from the main tow some three or four miles above the prospective landing and dropped back on the outside of the rear boats on the side next to the landing place. One of the crew then takes the end of the line ashore in a skiff and fastens it to a tree or stump. The river man generally knows every tree and stump on the banks. This done, his brothers of the crew cast loose the boat or barge, and the steamer steering away, it drifts or swings round to its landing. This is where the spring lines are utilized, as, if the line was attached to a boat at the ends or in the center, it would not swing to the shore. Our friend of the crew having landed his line, then jumps into his skiff, and by a strong pull overtakes the fleet, which has slowed up enough for the purpose, though it has constantly maintained headway. While the rudders are always in use, the stern wheel, in conjunction with them, is a strong factor in the stering. All the tow boats are supplied with an abundance of extra lines for emergencies.

During very high water, when the current at times

COAL FLEETS ON THE MONONGAHELA, AT PITTSBURG.

runs at eight miles an hour or more, it is necessary to use a small tug in front of the fleet to assist it in steering around sharp bends in the river and between the bridge piers. Especially is this the case at Cincinnati, where the bridges are so close together. This guide is also useful in avoiding other tows in the stream during the high stages of the river.

The steamboat includes in her tow fuel enough to last the entire trip, even when to New Orleans. As it is now the custom to tow the "empties" back, the fuel boats are dropped off at various landings along the route but partly unloaded, and are picked up on the return trip. It is evident what an advantage this lightening of the load is, and it is so nicely calculated that by the time the empties get back to the starting point the fuel is almost consumed, about enough being left for harbor purposes. In case of delays from any cause, however, or running short, fuel can be obtained at any landing of importance. It is only within the last ten or twelve years that empties have been towed back, but the more powerful steamboats now in use makes it profitable to do so. Formerly the empties were left to their fate of wreckage on the banks or sold for whatever they would bring, which was not very much. There is always some leakage in both barge and boat, and although the hand pump operated by a long wooden lever attached to the suction plunger is still in use, the steam syphon has practically superseded the old-fashioned affair.

Point Pleasant, at the mouth of the Kanawha River, is an important point for distribution. The tows coming out of that stream, and also coal coming by rail to be transferred to boats, are both accumulated at that point for re-shipment. The formation of the tows on the Kanawha differs somewhat from those on the Ohio, as they are usually not so long nor so wide.

The tows consisting entirely of coal boats are usually bound for southern ports, although some may be dropped off at Cincinnati and other points.

While starting from Pittsburg with an average of fourteen pieces, they may be increased on the way to the extent of thirty-eight to fifty at Louisville, all bound for Mississippi points and to New Orleans. Cincinnati is a large consumer of coal, and her method of handling it from the boats is a fair example of the general method used, which is both by hand shoveling and by the Eagle Claw Digger bucket. The digger takes up a ton of coal in each operation, and is without doubt the better and cheaper way.

The annual report of the Cincinnati Chamber of Commerce for 1900 notes a falling off in the receipts of coal, and it states that the average local consumption in recent years has been something over 60,000,000 bushels per year, about evenly divided between factory and household use. This includes the coal received by river from Pittsburg and the Kanawha, also by railroad from the Kanawha, Ohio, Kentucky and Tennessee districts.

Transport McPherson.—The McPherson has been towed to New York, having been pulled off the rocks on Fortune Island, Cuba, where she went ashore in August, 1900.

TANK STEAMER DEUTSCHLAND.

BY C. C. THOMAS.

Nearly all the countries of the world use our petroleum, and the business of transporting it is one of tremendous magnitude, for petroleum is one of the most important accompaniments of civilization. This is especially true of the manufacturing centers, and Germany is one of our largest customers. Trade in oil with Germany is under the control of the *Deutsch-Amerikanische Petroleum Gesellschaft*, which has its headquarters in Hamburg and New York, and every month twenty or more tank steamers leave the United States bound for German ports, carrying from 1,200,000 to 1,700,000 gallons each. Allowing time for repairs and other delays, each of these twenty steamers, say, makes an average of ten voyages a year, and on this basis the company sends Germany in the neighborhood of 850,000 tons of oil per year—a quantity that can be expressed in tons more easily than in gallons.

The *Deutschland* is one of the largest oil steamers, and has been satisfactory from the standpoints of durability and speed. Her May voyage this year was her sixty-eighth round trip between Germany and America, and these have been made in seven years. The vessel is of the following dimensions:—

Length over all	350 ft. 0 in.
Length on load water line	338 ft. 0 in.
Beam	43 ft. 8 in.
Depth to spar deck	31 ft. 0 in.
Depth to main deck	23 ft. 9 in.

Designed capacity—4,850 tons cargo—700 tons coal, and 200 tons water.

Draught, loaded—27 feet 6 inches aft—25 feet 0 inches forward.

The *Deutschland* has three decks—the lower deck 14 feet above the keel, and the main and upper decks 23 feet 9 inches and 31 feet, respectively, as stated above. The part of the ship used for oil consists of about 180 feet, commencing 92 1-2 feet forward of the after side of the stern post, and extending forward to the cofferdam separating the forward peak from the cargo space. This length of 180 feet is divided into eight compartments by athwart ship bulkheads, which extend to the main deck. Each of these compartments is again divided into two compartments, by a longitudinal bulkhead in the center of the boat, from the keelson to the upper deck, running the whole length of the cargo space. Between the main and upper decks, the cargo spaces, or oil tanks, are only 9 1-2 feet wide on each side of the longitudinal bulkhead, as there is a reserve coal bunker on each side of the ship, running the length of the tanks. The compartments in the middle, 9 1-2 feet wide, are known as expansion tanks, and the oil is allowed to fill these up to within about two feet of the upper deck. The coal bunkers alongside of the expansion tanks are not used on the trans-Atlantic voyage, and two small tanks have been built in these bunkers, extending about four feet above the upper deck, for carrying additional oil during the summer, when rough weather is not encountered as a rule. These are called "summer tanks," and are about 4 1-2 feet wide by 9 1-2 feet long, located amidships.

The cofferdam mentioned above is a space between the bulkhead of the forward end of the oil tanks, and a similar bulkhead 4 1-2 feet farther forward, the space between being intended as a safety compartment, which

can be flooded with water if desired. There is a similar space at the after end of the cargo tanks. The forward cofferdam is used for carrying oil, but the after one is left empty.

The capacity of the various tanks is as follows:—

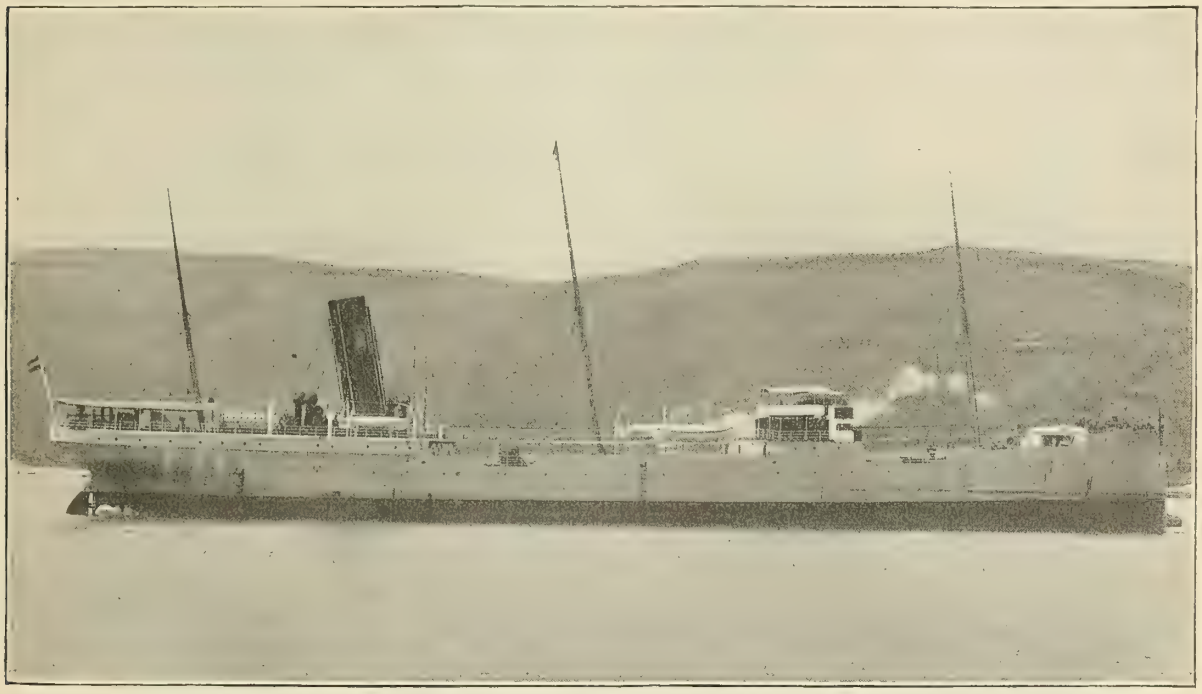
	Tons.
Ballast, or lower tanks	2,324
Middle, or tween deck tanks	1,818
Expansion tanks	559
Forward cofferdam	110
Summer tanks	110
Total	4,921

The pump room, containing the machinery for discharging the cargo, is just forward of the forward fire room, and extends down to the lower deck, where two oil pumps are located. These are duplex, horizontal pumps, with steam cylinders 8 inches diameter, oil cylinders 11 inches diameter, and a stroke of 10 inches. These pumps discharge the cargo in about twenty-two hours.

In the forward end of the ship are large trimming tanks, chain lockers, store rooms, and a general repair shop. There is also a large forecastle, in which are crews quarters, mess-room, etc. The deck house amidships contains the officers' quarters, two ample staterooms for supernumeraries, the steward's pantry and a large bathroom. Above these are the steering engine room, and chart room, these being surmounted by the bridge. The after deck house contains the galley, engineers' quarters and accommodations for the engine and fireroom staffs.

The structure of the boat, especially in the tanks, appears at first sight as being very heavy, but the good service rendered and small cost for repairs seem to justify the construction.

The main engine is vertical, triple-expansion, with cylinders 24 inches, 40 inches and 63 inches diameter, by 49 1-2-inch stroke, fitted with Stephenson link valve gear, with the rock shaft on the starboard side. The high pressure cylinder is forward and the low pressure aft. The high pressure cylinder has a piston valve 11 1-16 inches diameter at top, and 10 1-2 inches diameter at bottom, with a stroke of 7 1-16 inches when in full gear. The intermediate pressure and low pressure cylinders are fitted with slide valves and balance pistons, the stroke of the valves in full gear being 5 1-2 inches and 6 1-16 inches respectively. The reversing gear is of the "all round" type, the worm wheel and small single cylinder engine for turning the gear (cylinder 5 1-2 inches diameter by 6-inch stroke) being placed on the middle front column. Both the front and back main columns are of rectangular box section, and carry the main guides, which are fitted with water-



TANK STEAMER DEUTSCHLAND.

cooling connections. The columns are also used as oil tanks, and are piped up similarly to the main engine-room oil tanks, arranged, as are the latter, to be filled from deck.

The condenser is built into the framing of the engine, cast in one piece with the two forward back columns. It contains 1,400 3-4-inch tubes 11 feet long, or about 3,000 square feet of surface. The main exhaust pipe is of cast iron of circular cross section. The propeller is three-bladed, 16.4 feet diameter by 18.8 feet pitch, with bronze blades and a cast steel hub.

Two massive steel pump beams are worked off the intermediate pressure crosshead, for operating the air, circulating feed, bilge and sanitary pumps, all these pumps, together with a small brine pump for the evaporator, being bolted to the back of the condenser. The dimensions of the pumps are as follows:—

Air pump	23 5-8	in. dia. by 23 5-8 in. stroke
Circulating pump	14	in. dia. by 23 5-8 in. stroke
2 feed pumps	4	in. dia. by 23 5-8 in. stroke
2 bilge pumps	4	in. dia. by 23 5-8 in. stroke
1 sanitary pump	2 3-4	in. dia. by 23 5-8 in. stroke

The feed pumps mentioned above lift into a Weir heater on the main deck level, and from this an independent Weir pump feeds the boilers. Besides these pumps, there is an independent duplex fire pump, and a No. 16 Korting injector.

A twenty-five ton evaporator is carried, but not used, as the fresh-water tanks are of ample capacity for the voyage as now made. There is tank room under the engine space for fifty tons fresh water for fed make-up, of which thirty-five or forty tons are required per trip. Two tons are carried in the forecastle, four tons amidship and twenty tons aft, for washing, cooking, etc.

There are two main boilers, double-ended, side by side, with axes fore and aft. The diameter of the boilers is 12.4 feet, and the length 17.9 feet. Each end contains two furnaces, about 43 1-2 inches diameter.

THE COMANCHE IN DRY DOCK PREPARATORY TO LAUNCHING THE FORWARD END.

The fire bars are 6 feet 3 inches long, giving a grate surface in the eight furnaces of 181 square feet. The heating surface is 5,530 square feet, making the ratio of heating surface to grate surface equal 30.5. The boiler pressure is 165 pounds per square inch. On the upper deck is a donkey boiler 9 feet diameter by about 9 feet 4 inches long, built for 115 pounds steam pressure, containing 650 square feet heating surface and 21 1-2 square feet grate surface.

There are two wing coal bunkers abreast of the boilers, holding 240 tons each, and one reserve bunker forward of the boiler space, carrying 230 tons, making a total of 710 tons carried.

The stack is 7 1-2 feet diameter inside by 66 feet high above the grates, and is built of plates of little more than a quarter-inch thick at the base, and extending about 20 feet high, then 3-16 inch plates to the top.

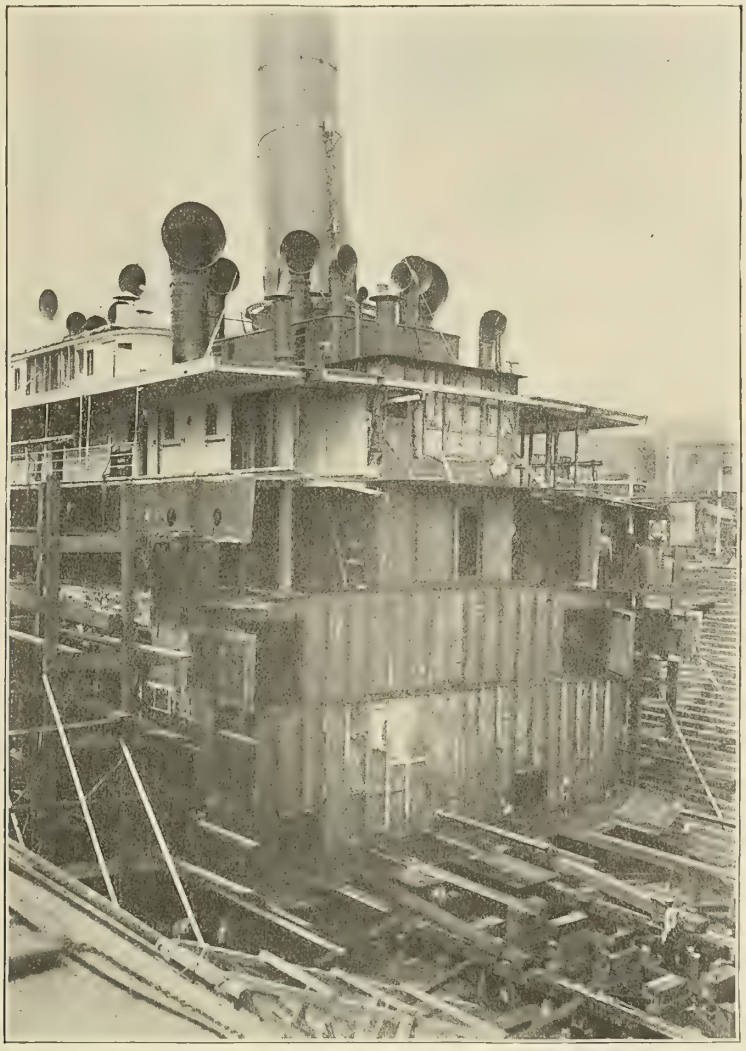
The engine makes, normally, about sixty-two revolutions per minute, and the speed of the vessel is then about 11 knots. The engine develops from 1,800 to 1,850 horse power with 165 pounds steam, and there is no difficulty in holding the pressure in the boilers at that power. There is at times difficulty in maintaining sufficient vacuum, notably in the Gulf Stream, but ordinarily the gauge shows about 24 1-2 inches when at sea. The engineers contemplate the substitution of a centrifugal pump for the present direct-acting circulating pump, with a view to remedying the difficulty encountered in warmer waters. Capt Bernhard Schierhorst has commanded the *Deutschland* on sixty-five of her sixty-eight voyages, and will complete this summer his one hundredth transatlantic voyage in the employ of the Deutsch-Amerikanische Petroleum Gesellschaft.

Lengthening a Ship Under Difficulties.

The lengthening of the Clyde Line steamer *Comanche* recently by the Kensington Shipyard Company, Philadelphia, shows the large resources of a small shipyard and the way in which each and every part of it can be brought in service for performing a single difficult operation. As the head of the dry dock in this yard lies close to a street, there was not room to allow for purchases and leads for drawing the forebody towards the head of the dock, so the vessel was floated in stern first and ways built under the forebody to the gate. The hull was cut apart forward of the boiler room, and by springing off two bow plates two main purchases were made fast to a heavy oak toggle placed on the inside of the stem. As it was of course impossible to use the gate as an anchorage for these purchases, a bridle of 4-inch steel wire was made secure to mooring posts on either side of the dock and on the piers. The

purchases were drawn tight by steam winches, and the ship moved about 4 feet and then stuck. Two more purchases were placed in the bottom of the dock, one on either side, and made fast to the launching ways; but two subsequent attempts to move her only resulted in breaking a 4-inch steel rope, tearing out a mooring post and loosening some sheet piling at the anchorage. The leads were now changed to new anchorages and another pull moved her 11 feet further. Then a 6-inch hawser parted, and later the teeth were broken off the gearing of the winch. Two tug boats were started; care being taken to produce uniform strains on the several purchases, and the obstinate forebody was at last pulled into place, having been drawn in all 48 feet 6 inches. Hydraulic jacks had been used to start her at each of the various trials.

During the three days of this launch the weather had been excessively hot, so that the tallow had quickly melted and allowed the ground and launching ways to come together. This made the friction between the two surfaces very great, especially as the weight per square foot of surface was 2 1-4 tons. The



THE COMANCHE, SHOWING THE PLACE AT WHICH THE HULL WAS CUT IN TWO.

then called in and given the lines from the upper purchases, and the lower leads were taken to a pile driver and a second winch. The combined pull of all did not move her. In the last and successful attempt the main purchases were led to the chains of a marine railway, which is near the dry dock, and the carriage disconnected. One of the lower purchases was brought to the ship's capstan, which was run by compressed air, the other purchases remaining at the pile driver. It was also deemed best to place two additional purchases in the bottom of the dock attached to the frame of the ship forward of the cut. The various engines were bow always moved by jumps of from 1 1-2 to 2 feet, and the final jump landed her beyond the line, breaking to splinters the stops that had been put up at the end of the ways to hold her. However, as the material for the new length had been ordered full no attempt was made to move her back. The forebody had traveled almost in a straight line, and by the use of jacks the alignment was perfected.

Navy Estimates.—The estimates for the Bureau of Ordnance of the United States Navy for the year ending June 30, 1902, are $7,457,855.

DESIGN FOR A SEVEN MASTED SCHOONER.

There seems to be no limit to the extension fore and aft of the favorite schooner rigged type of vessel. Passing beyond the limits of the traditional three masted vessel we have had in somewhat rapid succession four, five and six, and now seven masted schooners. The accompanying illustrations refer to a recent vessel of this type designed by Crowinshield, of Boston, for Capt. J. G. Crowley and others, and building at the Fore River Iron Works, Quincy, Mass.

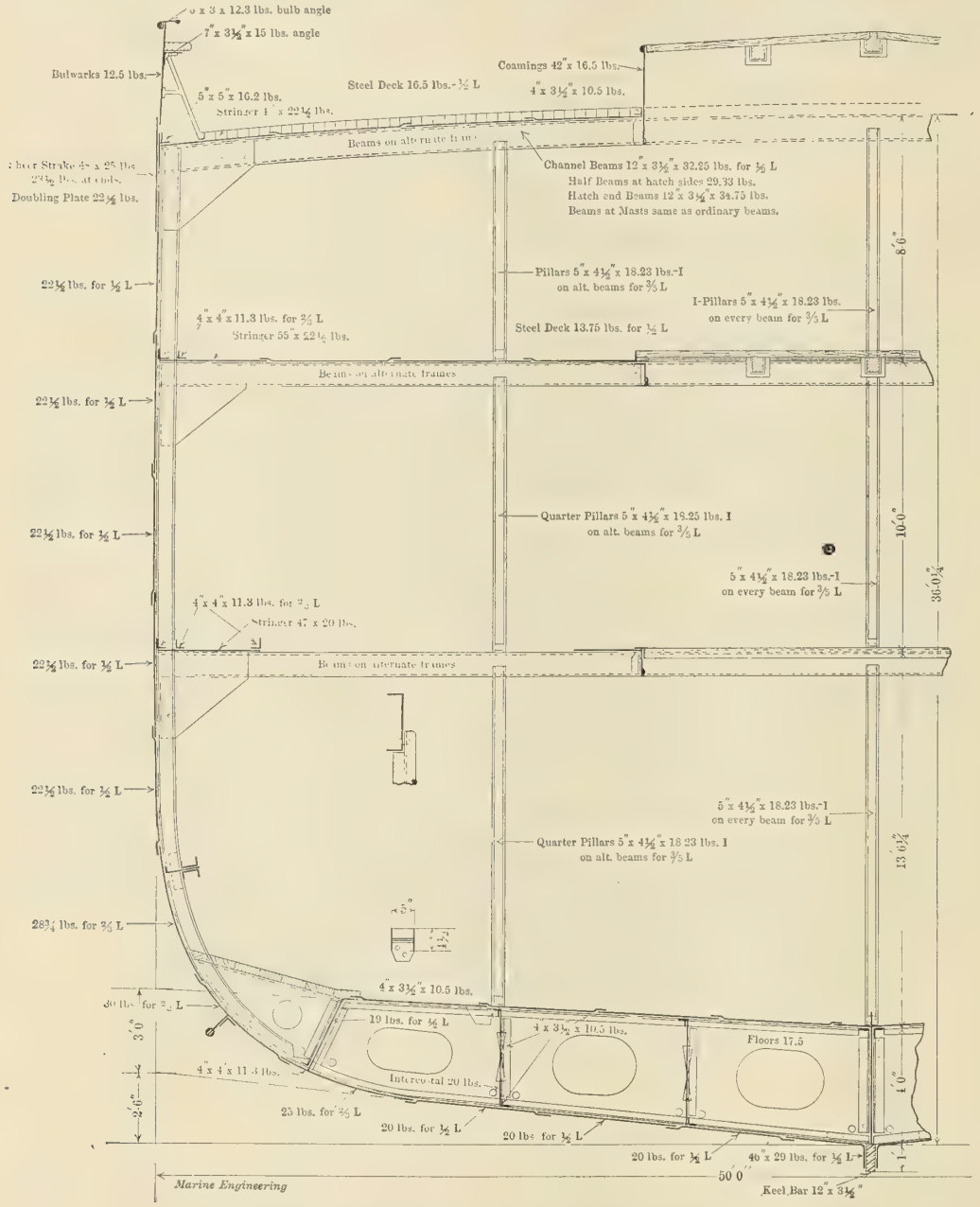
Following are the principal dimensions:—

Length over all	395 ft.
Length on load water line	388 "
Beam moulded	50 "
Depth from top of keel plate to top of upper deck beam	34 ft. 5 in.
Draft to L. W. L.	25 " 6 "

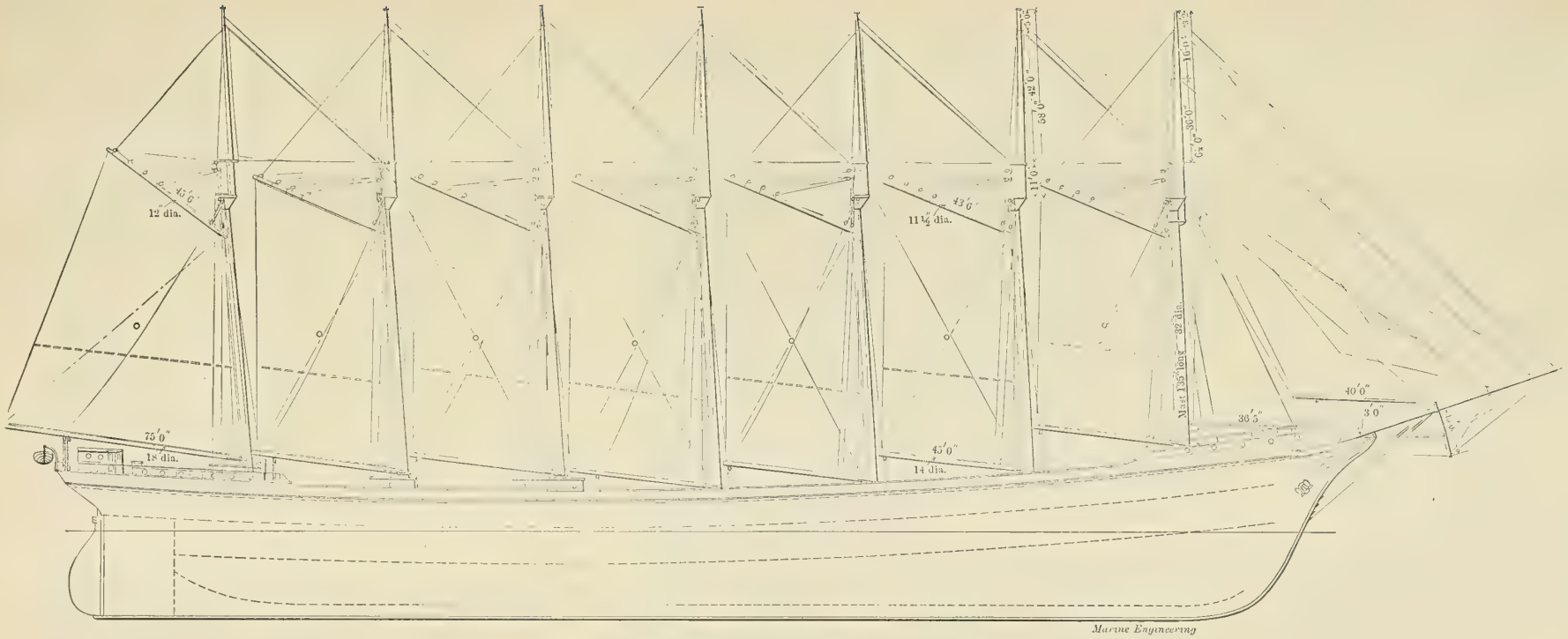
The construction of the hull throughout is generally of open hearth steel, conforming to the requirements of the American Bureau of Shipping and Bureau Veritas.

The midship section shown below will give a general idea of the leading structural features, together with the chief scantlings.

The cellular double bottom worked as shown extends as far fore and aft as practicable with good workmanship. The plating as shown is on the in and out "Joggle" system. All plates except those of the sheer strake and garboard are to be lap butted. The sheer strake butts are to be double strapped and triple riveted, while the garboard strake butts are to be single strapped and triple riveted. All longitudinal


Bulwarks 12.5 lbs.
Steel Deck 16.5 lbs.-½ L
Coamings 42" x 16.5 lbs.
4" x 3½" x 10.5 lbs.
Channel Beams 12" x 3½" x 32.25 lbs. for ½ L
Half Beams at hatch sides 29.33 lbs.
Hatch end Beams 12" x 3½" x 34.75 lbs.
Beams at Masts same as ordinary beams.
Doubling Plate 22½ lbs.
22½ lbs. for ½ L
Pillars 5" x 4½" x 18.23 lbs.-I on alt. beams for ⅗ L
I-Pillars 5" x 4½" x 18.23 lbs. on every beam for ⅗ L
Steel Deck 13.75 lbs. for ½ L
Beams on alternate frames
Quarter Pillars 5" x 4½" x 18.25 lbs. I on alt. beams for ⅗ L
5" x 4½" x 18.23 lbs.-I on every beam for ⅗ L
Stringer 47 x 20 lbs.
283¼ lbs. for ⅗ L
4" x 3½" x 10.5 lbs.
19 lbs. for ½ L
Floors 17.5
Intercostal 20 lbs.
25 lbs. for ⅗ L
20 lbs. for ½ L
40" x 29 lbs. for ½ L
Keel Bar 12" x 3½"
8'6"
10'0"
36'0¼"
13'6¼"
4'0"
50'0"
Marine Engineering

MIDSHIP SECTION OF SEVEN-MASTED STEEL SCHOONER.



SAIL PLAN OF SEVEN-MASTED STEEL SCHOONER.

seams will be double riveted. The sheer strakes are to be doubled for one-half the length amidships, twenty-five pounds outside and twenty-two and one-half pounds inside.

Three tiers of deck beams are to be fitted throughout the vessel. The beams will be of channel section 11 by 3 1-2 by 3 1-2 inches by 32.25 pounds. All beam knees are to be three times the depth of beam, with bracket plates fitted as shown.

In addition to the steel decks, as shown, the upper, forecastle and poop decks will be covered with wood, the planks being 4 by 3 1-2 inches and secured to the steel decks with galvanized iron bolts set up with nuts from underneath. The heads will be sunken as usual, bedded in oakum and white lead, and covered with turned dowels bedded in white lead or marine glue. The seams will then be thoroughly caulked in the usual manner.

There are to be six main hatchways 14 feet by 18 feet, fitted as shown in the figure. The coamings will be 30 inches in height above the plating of the upper deck, with square corners, and fitted with suitable half-rounds on the upper edges.

Bilge keels as shown are to be fitted for one-half the length amidships, 18 inches deep and with two three-inch half rounds fitted on the outer edge.

The general arrangement of the masts and rigging will be as shown by the sail plan above. The total sail spread will be about 38,000 square feet. The standing rigging, and in special cases, the running rigging for lower sails will be of the best quality wire rope. Other rigging will be of the best quality manila cordage.

For living spaces four deck houses will be fitted, for galley, engine room, carpenter room and main cabin. The forecastle will be fitted with bunks for the crew. The quarters for the officers will consist of main cabin, pantry, large captain's cabin and state rooms. These will be finished in hard wood and supplied with the usual fittings and accommodations. For heating these quarters in cold weather steam radiators supplied with steam piped from the boiler will be fitted.

In the way of small boats the schooner will carry one 26 foot whale boat, and one 17 foot stern boat, fitted with center board, sails and spars.

The mechanical equipment of modern sailing vessels forms an especially interesting feature of the application of engineering to the development of sailing craft. In the present case the equipment is especially complete, and consists of the following principal features:—

Boilers.—There will be two vertical boilers 56 inches diameter by 90 inches height, one in the forward house and the other in the after house, with all fittings and appliances complete. They will be built for a pressure of 100 pounds per square inch. One Hancock locomotive inspirator and one Watson injector of suitable size will be provided for feeding each boiler.

Engines.—There will be one 9 inches by 10 inches Hyde double cylinder ship engine, with friction drum for forward house, with an extended drum shaft of suitable size fitted on the outer end. There will also be five 8-inch by 8-inch Hyde hoisting engines, with link motion, to go on deck as required, with suitable galvanized iron winch heads on each end of the drum shaft.

Condensers.—There will be two coil condensers in a casing of cast iron, not less than 1-4 inch thick and 38 inches diameter, and of sufficient cooling surface to condense the exhaust steam from each hoisting engine. A tank of not less than 300 gallons capacity will be fitted with each condenser.

Pumps.—There will be two direct acting steam pumps for main ship purposes, with steam and water cylinders, each 12 inches diameter by 12 inches stroke. There will be also two 6-inch by 4-inch by 6-inch duplex donkey pumps of the packed piston type, with composition water ends. Each pump will have copper air chambers of suitable size. One of these pumps is to be located near each engine, and to be piped for use as a circulating pump and also for washing decks and fire purposes. Two hand pumps of the deep chamber type will also be fitted for special or emergency purposes.

Windlass.—The windlass will be of the Hyde pump brake type with double geared messenger attachment and iron bitts. Wildcats fitted for 2 3-4 inch chain and bushed with composition will be fitted.

A capstan and winch head will also be provided in connection with the windlass, operated by gearing from the windlass countershaft.

Steering Gear.—A No. 11 Hyde improved Robinson steam steering gear will be fitted suitable for a 10-inch steel rudder stock.

VIEW OF COSMOPOLITAN WORKS OF HONG KONG AND WHAMPOA DOCK CO.

Express Steamship La Savoie.—The new express steamship *La Savoie* of the Compagnie Generale Transatlantique, made an average speed of 20 1-2 knots on her maiden trip from Havre to New York. Her general dimensions are, length, 580 feet; breadth, 60 feet; depth, 39.6 feet; displacement, 15,380 tons; horse power, 22,000. An illustrated article on *La Savoie* will appear on these pages at an early issue.

Vessels Lost, Condemned, Etc.—Lloyd's Register reports that the corrected list on July 15th, of the total number of steam vessels of all nationalities lost, condemned, etc., during the year of 1900 was 296 of 386,304 gross tons, and that the number of sailing vessels lost, etc., during this period was 552 of 290,878 gross tons.

Bainbridge.— The torpedo boat destroyer *Bainbridge* was launched from the yard of Neafie & Levy, Philadelphia, on August 27th. She is 245 feet long, 23 feet beam, and is contracted to develop a speed of 29 knots. She has since made two preliminary builders' trials, on which the engines and boilers worked most satisfactorily.

DOCKING FACILITIES AT HONG KONG.

BY ROBERT SANFORD RILEY.

Although a British possession, Hong Kong is thoroughly cosmopolitan, and recognized by all nations as general headquarters for shipping interests in the "Far East." With the enormous development of commerce the facilities for docking and repairing the visiting ships have increased proportionately. During recent years our own navy and transports have contributed no small share toward this industry. Comparatively little building is done, except of small launches, shallow-draft steamers, and lighters. Prices of material naturally run high, but Chinese labor is cheap.

The Hong Kong and Whampoa Dock Company receive only ships under the Chinese flag. The result is that those docks and apparatus now lie almost deserted. In 1880 this enterprising company was further enlarged by the absorption of the Cosmopolitan Dock Company, of Hong Kong. Today their capital is $1,250,000, in fully paid-up shares, which are hard to get at six and one-half times their original value. This success is due largely to the foresight and management of Mr. David Gillies, who has been the leading spirit in the enterprise since its foundation. He is still at the head of affairs, and holds a unique position among the influential men of the China Coast.

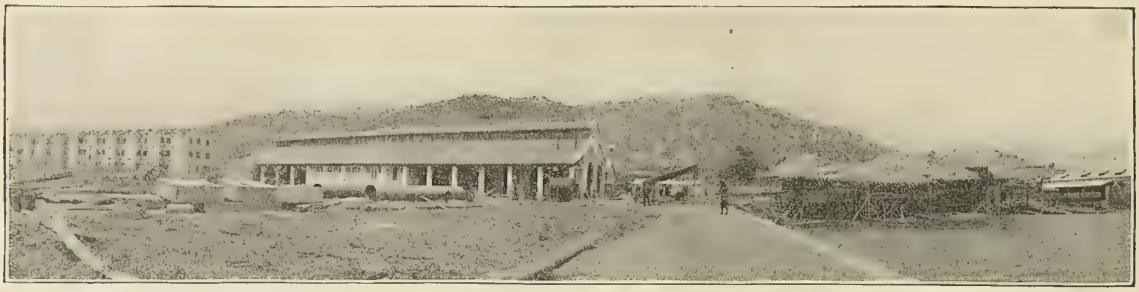
The chief works of the company are near the city of Kowloon, on the mainland across the harbor from

WITH UNITED STATES STEAMSHIP ALBANY, IN DRY DOCK, AFTER DAMAGE IN SUBIG BAY.

practically monopolize all the important repair work. The building and maintenance of the smaller craft is shared by the smaller yards, among which those of Geo. Fenwick and Co. and W. S. Bailey and Co. are the most important. Besides these there are a number of small yards controlled entirely by Chinamen, but their only remarkable feature is the lack of modern time-saving appliances. The employees of the Hong Kong and Whampoa Dock Co. alone number over eight thousand, which may give some idea of the amount of repair work done in this great port. At one time recently no less than seven ships of the United States Navy were undergoing repairs in this company's yards. They were the United States Steamships *Kentucky, Oregon, Brooklyn, Newark, Yorktown, Bennington* and the *Isla de Luzon.*

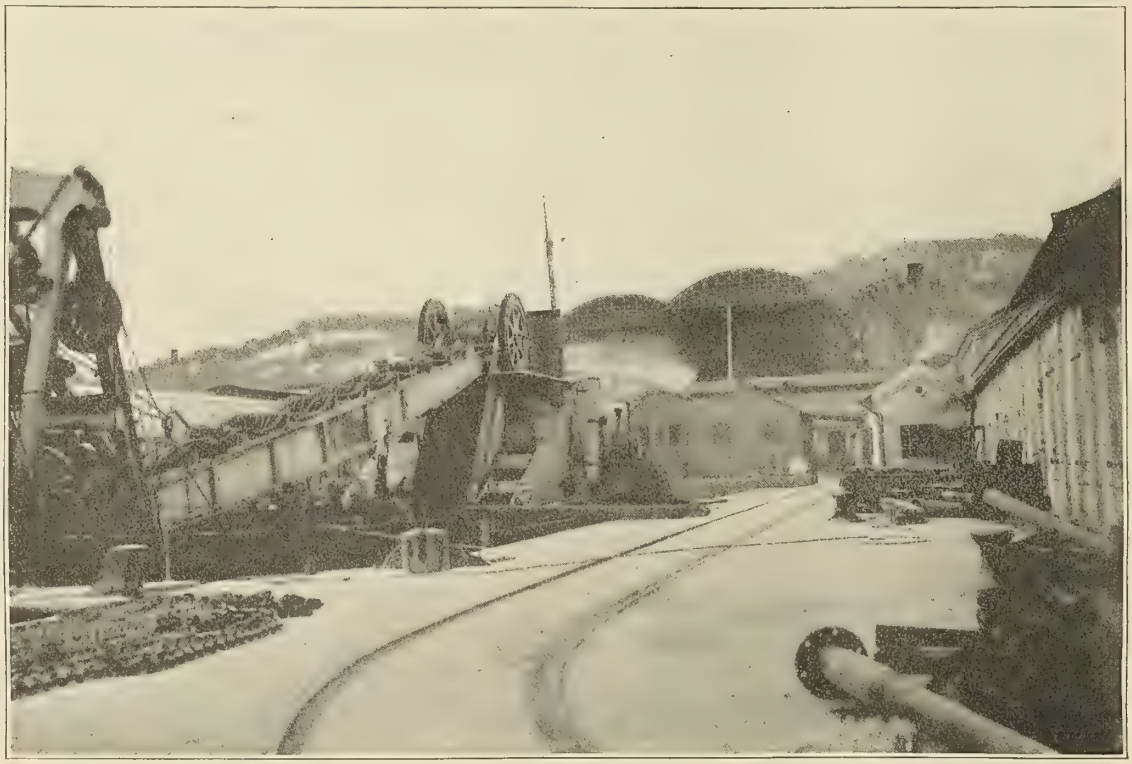
This company was founded in 1863, with a capital of $240,000, and started business at Whampoa, on the Canton river. By 1867 they had absorbed two other smaller companies in Hong Kong. In 1875 the original property in Whampoa was sold to the Chinese government. The works were to continue running, but to Hong Kong. They cover an area of fifty-three acres, with a water frontage of 3,000 feet. Besides these are two branch works, the "Cosmopolitan" on the mainland, about four miles west of the Kowloon works, and the "Aberdeen" docks, situated on the south side of the island of Hong Kong. Altogether there are six granite dry docks, three at Kowloon, one at the "Cosmopolitan," and two at the "Aberdeen" works. Their lengths on line of blocks are 576, 371 and 264; 466 and 430. 333 feet, respectively. There are also two marine railways at the main works, which measure 260 and 240 feet on line of blocks. The largest dock at the main works is shown with one of the Canadian Pacific Railway Company's *Empresses* on the blocks. It is 86 feet wide at the top, 70 feet at the bottom, with 30 feet of water over the sill at ordinary spring tides. It was recently enlarged, to be ready for the new Pacific Mail steamers building at Newport News. This is called the "Admiralty" dock, and cost $850,000, toward which the British government gave assistance, and in return holds priority of entrance for ships of the Royal Navy till the year 1908. By that time the dock now under

construction in the Hong Kong naval yard will be complete, and able to handle anything in the British Navy. The Hong Kong and Whampoa Dock Co. also have a new dock under contract, which will be 800 feet long, 110 feet width of entrance at top, with a low-water draft of 30 feet. The rise and fall of the tides is about 8 feet. Granite wharves surmount the water front, on which are 100-ton sheer legs. The "Cosmopolitan" docks are similarly equipped. The view of the latter works shows the United States Steamship *Albany* in dry dock for repairs, after running aground in Subig Bay.



YARD OF BAILEY AND CO. NEAR KOWLOON.

roofs. The doors and windows are framed of teak wood. That the buildings are strong is proven by the typhoons they have to withstand occasionally. The main machine shop is a fine, lofty building 168 by 285 feet. All the floor space is covered by electric traveling cranes, running along bays of 56 feet span. The boiler shop is 50 by 200 feet, also fitted with traveling cranes, as are all the other important shops. Adjoining this is the ship-building shop, 90 by 200 feet. The blacksmith shop is 150 by 200 feet, with fifty-two fires and six steam hammers. A separate building, 65 by 180 feet, 65 feet high, is fitted for extra heavy forging with



VIEW IN KOWLOON WORKS OF HONG KONG AND WHAMPOA CO., WITH DREDGE IN DRY DOCK NO. 2.

The shop equipment of the main works is well adapted for the great variety of work they have to handle. The shops stand back from the water front against red clay hills that have been cut away to make room for them. The buildings are large and airy. Granite is the most prominent material in their construction, with cast iron pillars and steel trussed iron three large hammers and cranes. The foundry, sawmill, pattern and coppersmithing shops are conveniently situated. There is also a first-class galvanizing plant. The main storehouse is a fine building 65 by 200 feet, equipped with an electric traveling crane. Above is the mould loft. A million dollars' worth of material is carried in stock, consisting of iron and

steel plates, angles and bars of all sizes, timber, copper and every description of engine and ships fittings.

The equipment of machines in all the shops is modern and complete. All the heavier machines, such as boring and planing machines, binding rolls, punches and sheers, are of English or Scotch manufacture. Some lighter American machines have recently been introduced, and have made their usual good impression. Duplicate orders now awaiting fulfilment furnish satisfactory evidence of this. Among the wood-working tools the Fay Company, of Cincinnati, are well represented. In the machine shop some Jones and Lamson lathes and an Acme automatic screw machine are in high favor with the management. The entire works are being equipped with electric drives from a central plant. The various capstans and winches about

VIEW OF KOWLOON WORKS OF HONG KONG AND WHAMPOA CO.

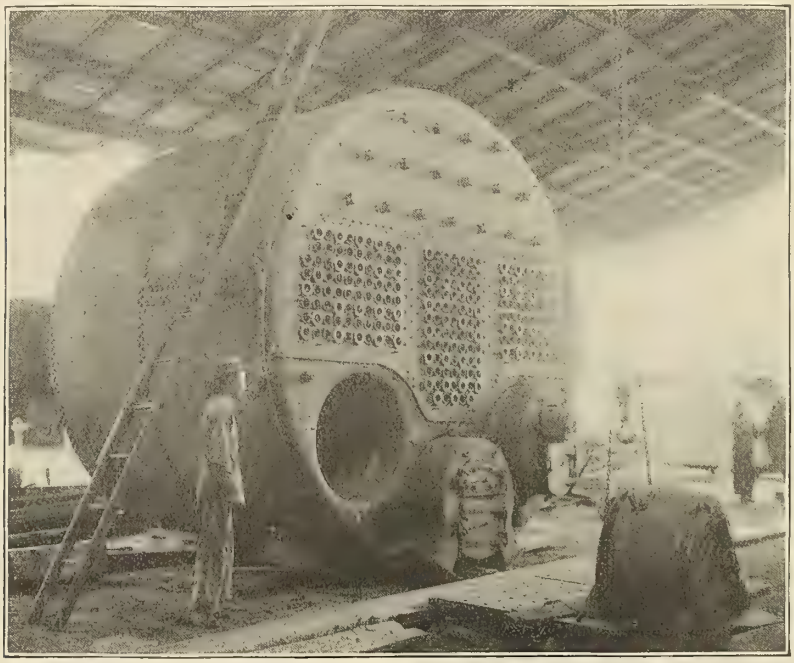
H. M. S. POWERFUL IN ADMIRALTY DOCK OF HONG KONG AND WHAMPOA CO.

the yard are run by hydraulic pressure. Air pressure is available for pneumatic tools from a compressor built by the Ingersoll-Sergent people, of New York. A standard gauge railway with locomotives and cranes connects all the buildings and docks. The branch works of the company are also well equipped with shops and machinery, but not on such a large scale as the main works.

All the manual labor is performed by Chinese. They are directed by a staff of ninety Europeans, who live in spacious houses provided by the company. The labor problem here consists in training up skilled mechanics faster than they are taken away to supply the growing needs of the China Coast. As a pioneer in this line these works have been a training ground for other similar industries. They carry as many Chinese apprentices as possible, but the demand for labor so trained is such that there is always a scarcity. Wages seem ridiculouslly low compared with our standards. Machinists and other tradesmen get forty to fifty cents a day. Inexperienced coolies may be had without number for ten to fifteen cents a day, but their uselessness for this class of work is astonishing.

All the companies mentioned find their business increasing rapidly, and are constantly making additions to their plant and facilities. Geo. Fenwick and Co. already do considerable repair work where docking is not required. W. S. Bailey and Co. will shortly have a marine railway in operation. Several new projects are also on foot, and it is possible that before long another concern may start business on a scale large enough to compete with the Hong Kong and Whampoa Dock Co.

WORKMEN LEAVING SHIP YARD.



BOILER FOR SHALLOW DRAFT STEAMER BUILT BY GEO. FENWICK AND CO.

Wind Driven Dynamos.

The Antarctic ship *Discovery*, which recently left England on an exploring expedition to the South Pole, has some specially interesting lighting features. The most prominent of these is a large windmill, as shown in the engraving, mounted on the upper deck forward of the foremast. The quantity of oil which would be

required to light the ship during her four years absence would take up too much space otherwise needed for storing the supplies and instruments of the expedition. It was therefore decided to light the vessel by electricity, and to use wind power for driving the two dynamos. These supply the current to a battery of accumulators placed in the hold. With dynamos running at such varying speeds as would naturally follow when driven by wind mills, it is impossible to charge the accumulators. This difficulty was overcome by fitting one of the machines with an equalizer, which increases or decreases the resistance proportionately with the number of revolutions, so that a practically uniform current is supplied the accumulators. An automatic switch makes and breaks the circuit upon the starting or stopping of the mill, and a simple contrivance rings a bell when too much current is being taken from the accumulators.

The mill and dynamos are made portable, so that they may be set up on the ice and connected with the accumulators by means of a cable.

WIND MILL FOR DRIVING DYNAMOS ON ANTARCTIC SHIP DISCOVERY.

The *Discovery* was specially built for this expedition, which is sent out under the auspices of the Royal Geographic Society. No iron is used in her construction because magnetic survey work is one of the chief objects of the expedition. She is of such a form that if ice closes in around her it is expected that the pressure of ice on her sides will raise her above the floes.

Report on the Trials of the H. M. S. Hyacinth and Minerva.

The following is the statement of the president of the Boiler Committee, upon the trials of the British cruisers *Hyacinth* and *Minerva*, from Davenport to Gibraltar and return, July 6 to 20, 1901. The *Hyacinth* is fitted with eighteen Belleville boilers, and the *Minerva* has eight of the Scotch type. As mentioned in Marine Engineering, of August, 1901, this test of endurance and economy was made to compare the two types of boilers. The two ships are almost of the same size.

Representatives of the Boiler Committee, consisting of the president, three members, and the joint secretaries, embarked in H.M.S. *Hyacinth* and *Minerva* at Davenport about 2 p. m. on the 6th July. The ships sailed at about 3 p. m. on that day, and started working up to 7,000 horse power. It was intended that the ships should maintain 7,000 horse power till all the coal, except that in the reserve bunkers—82 tons—was exhausted. By 3.45 p. m. the revolutions in the *Hyacinth* were 152 per minute and the horse power 6,994, and the trial was considered to have started from that time. The *Minerva's* trial commenced at 4 p. m. The *Minerva* soon showed that she was the faster ship, and steadily drew away from the *Hyacinth*. By midnight, on the 7th, the *Minerva* was about 4 1-2 miles ahead.

When passing through the Straits of Gibraltar, early in the morning of the 9th, a fog was encountered, the *Minerva* eased down for 55 minutes, while the *Hyacinth* had to ease down for two hours. On running out of the fog both ships again worked at 7,000 horse power.

At 4.30 p. m. on the 10th July, a bolt of the ahead excentric strap of the starboard intermediate engine of the *Minerva* broke, and the starboard engines had to be stopped; the port engines continued running. The strap was found to be damaged and had to be replaced by the spare one. This work was carried out in about two hours, and at 6.40, the starboard engines started working again, and were worked up to the required power.

It had been arranged that the water in the reserve tanks of both ships should be used as the only make-up feed water until it was reduced to 20 tons, in order that the amount of make-up feed used per day might be accurately determined. When the reserve had been reduced to 20 tons, this water was to be kept intact in the tanks ready for use in case of emergency, and all make-up required was to be obtained from the evaporators.

Special reserve tanks had been fitted in the *Hyacinth* to hold about 100 tons; this, added to the original reserve tank stowage, gave a total reserve tank stowage of about 140 tons. The total reserve stowage of the *Minerva* was about 170 tons.

When the amount was reduced to 35 tons in the *Hyacinth*, the staff engineer asked to be allowed to start the evaporators, on account of the difficulty of getting the water out of the tanks by the special pump fitted for these trials. Two Weir's evaporators working with exhaust steam were started at 5.30 a. m. on the 9th, and the two Normandy's during the afternoon of the 10th.

At 1.15 a. m. on the 11th July, the staff engineer of the *Hyacinth* reported the engines would have to be eased on account of the large loss of water, and the trial was abandoned from 1 a. m. All the evaporators were working at this time, and in addition to the water from the reserve tanks, 25 tons of drinking water had been used for boiler make-up. The *Hyacinth* returned to Gibraltar at slow speed, arriving there on the evening of the 11th.

The *Minerva* continued steaming at 7,000 horse power till 11 p. m. on the 12th, at which time there were still 39 tons of coal in the bunkers, not including the reserve, and 20 tons of water remained in the reserve tanks.

The average horse power of the *Hyacinth* was 7,047 for 103 1-4 hours, with a coal consumption of 1.97 pounds, and the distance run was about 1,810 miles, at an average speed of 17.6 knots; the *Minerva's* horse power was 7,007 for 147 hours, with a coal consumption of 2.06 pounds, and the distance run was about 2,640 miles, at an average speed of 17.96 knots.

On the night of the 10th July, flaming occurred at the after funnel of the *Hyacinth*, but no flaming is reported from the *Minerva*. On examination of the *Minerva's* boilers after arrival at Gibraltar, it was found that the openings in the Admiralty ferrules were seriously choked, the size of the openings, in some cases, being reduced to about one-third the original.

The boilers and engines in both ships worked well on the way out, with the exception of the excentric strap bolt of the *Minerva*, and a number of leaks which developed in connection with the boilers of the *Hyacinth*; these latter appeared to become worse after the engines were suddenly eased on entering the fog on the 9th, on which occasion the pressure of the boilers became sufficiently high as to lift the safety valves.

The loss of water in the *Hyacinth* was at first attributed to leaky feed suction pipes, but during the stay at Gibraltar these pipes, the feed and hotwell tanks, and the boilers and boiler blow outs, were water pressure tested, and no leaks beyond those already known to exist in the boilers were discovered.

As no serious leaks could be discovered during the stay at Gibraltar, the leaky joints in the *Hyacinth's* boilers were re-made by the ship's staff, and on Tuesday, 16th, the ship was taken out for a run at about 7,000 horse power, to test the amount of feed water being lost. This was found to be at the rate of 55 tons a day from the records of a six hours' run; after being under way three hours the engines were eased by order from the deck, and the boiler safety valves allowed to blow off freely, so as to reproduce the circumstances that occurred in the fog on the 9th July. The rate of loss of water was calculated from a steady three hours' run before easing and a steady three hours' run after easing, a fresh start being made after easing down, and the water lost during the period the safety valves were allowed to blow being neglected. On return the *Hyacinth* anchored in the bay at 4.30 p. m., and all fires were drawn except those in two boilers. The *Minerva* steamed from the Mole with three boilers alight, and anchored in the bay at about the same time as the *Hyacinth* anchored; fires were drawn from two boilers.

Gibraltar dockyard made a spare excentric strap for the *Minerva* and delivered it on morning of 17th.

At 3.30 p. m. on the 17th, the committee embarked. At this time the *Hyacinth* had two boilers alight for auxiliary purposes, and the *Minerva* one.

The boilers of both ships had been thoroughly cleaned during the stay at Gibraltar.

Before the ships began the homeward run, a communication as follows was handed to the captain of each ship:—

"On the responsibility of the ship's officers, a large quantity of fresh water for boiler make-up has been taken as a precautionary measure in the double bottoms of the *Hyacinth*, and in the extra reserve tanks of both ships. These latter tanks were fitted specially for the outward trials, and do not form a part of the ship's ordinary fittings. It is to be understood that, except the amount originally allowed to each ship—about 40 tons in the ordinary reserve tanks—this is to be used in cases of emergency only during the homeward run. The evaporators, if they have not been in use before, are to be started as soon as the 40 tons mentioned have been used up, and then the make-up required is to be obtained from the evaporators. If the evaporators are unable to supply the whole of the make-up required, their use at maximum obtainable output is to be maintained while the remaining water used may be taken from the reserve tanks."

In the case of the *Minerva*, the expenditure of the 40 tons in question was not exceeded, but the *Hyacinth* had used the 40 tons by 5.15 a. m. on the 20th, although her evaporators had been working practically all the time.

At the conclusion of the trial it was reported that 98 tons of water had been used from the reserve tanks of the *Hyacinth* as make-up feed, in addition to that made by the evaporators.

The ships were informed that on the signal being made at an unknown time after 4 p. m. by the senior officer at Gibraltar, fires were to be lighted in the boilers not at work, and the ships were to proceed to Portsmouth as fast as possible. The signal was actually given at 4.27 p. m.

The engines of both ships had been warmed through by steam from the boilers alight.

At 4.30 p. m. the *Hyacinth's* engines were worked slowly in accordance with orders from the deck, steam being supplied by the two boilers which were alight. At 4.52 the after group of boilers was connected up. At 5.5 the forward group, at 5.9 the middle group were connected up, the steam pressure being 200 pounds. At 5.20 p. m. the *Hyacinth* was proceeding at 150 revolutions per minute, the horse power being nearly 7,000.

At 4.30 p. m. the *Minerva's* engines were worked slowly, in accordance with orders from deck. The boilers were connected at the folowing times:—

2nd, 4.55; 3d, 5.2; 4th, 5.7; 5th and 6th, 5.10; 7th, 5.12; 8th, 5.15.

The engines were working up to full power at 5.16 p. m., but had to be eased several times between 5.30 p. m. and 8 p. m., on account of excentric straps warming up.

At 5.15 a. m., on the 18th, the *Hyacinth* was about six miles ahead of the *Minerva*; but, both ships running into a fog, the *Minerva*; ran up to the *Hyacinth*, and at 9.30 a. m., on the 18th, on emerging from the fog, the ships were nearly level, the *Minerva* being slightly ahead. Both ships then worked up to the maximum power, but throughout the day the *Minerva* was stated to have gained one-third of a knot an hour on the *Hyacinth*. At 7 p. m. another fog was encountered and the ships went slow throughout the night, keeping close to each other.

At 9 a. m. on the 19th they were again level. The fog having cleared both ships went on again, and during the day the *Minerva* gradually drew ahead, and was stated to be going quarter of a knot an hour faster than the *Hyacinth*. At 7 p. m. the *Hyacinth* again eased, owing to fog, and went slow till 5 a. m. on the 20th, the *Minerva* being out of sight ahead.

The *Hyacinth* then steamed at over 9,000 horse power till 6.10 p. m. on the 20th, when the fires of No. 10 boiler were drawn on account of a burst tube. One man was slightly injured by the steam and hot coal.

At 9.50 p. m. the trial in the *Hyacinth* finished, the ship being then off St. Catherine's, and she arrived at Spithead at 11.30 p. m.. The *Minerva* had passed St. Catherine's at 8.20 p. m., and anchored at Spithead at 9.45 p. m.

The coal used by the *Hyacinth* on the way home was stated to be 550 tons; by the *Minerva*, 451 tons.

The *Hyacinth's* evaporators were all in use practically the whole time, but the *Minerva* used hers but little.

The maximum power developed by the *Minerva* was about 8,700 horse power, while that developed by the *Hyacinth* was nearly 10,000 for at least two hours, during which time the *Hyacinth* did not perceptibly gain on the *Minerva*. The *Hyacinth's* average power when running clear of fog was about 9,400, and the *Minerva's* about 8,400 horse power.

From the results of the outward run it appears that the radius of action of each of these vessels at 7,000 horse power, as far as the coal is concerned, should be, roughly, *Hyacinth*, 2,930; *Minerva*, 3,000 miles.

No difficulty was experienced in either ship, at any part of the outward or homeward runs, in keeping up a sufficient supply of coal to the fires.

Fire Boat New Yorker.—Specifications and plans have been drawn by H. de B. Parsons, Consulting Engineer, New York City, for extensive alterations to the fire boat *New Yorker*, estimated at $40,000, including Scotch boilers, repairs to engines, new frames, etc.

American Shipbuilding Co.—The annual report of the American Shipbuilding Company for the year ending June 30, 1901, is very favorable. The financial statement is as follows: Resources—plants and property, $14,633,683; additions and improvements, $359,613; material on hand, $549,315; accounts and bills receivable and cash, $1,976,155; work under construction, balance due, $1,187,544; total, $18,706,312. Liabilities—Preferred stock, $7,900,000; common stock, $7,600,000; accounts payable, $1,214,008; bills payable (since paid), $250,000. The earnings were $1,998,542, from which $553,000 dividends were paid. The balance, less $271,904 depreciation and maintenance, plus $568,665, previous surplus, makes the surplus June 30, $1,742,303. President W. L. Brown says: "The business of the company for the past twelve months has exceeded in volume that of the previous year, and the prospects for the coming year are favorable."

Marine Engineering

Published Monthly by

MARINE ENGINEERING,
INCORPORATED

309 Broadway - - - New York.

H. L. ALDRICH, Treasurer and General Manager.

PROF. W. F. DURAND, Advisory Editor.
F. D. HERBERT, Associate Editor.

Branch Offices.

Philadelphia, Pa., Mach'y Dept., The Bourse, S. W. Anness.
Detroit, Mich., Hodges Building, L. L. Cline.
Boston, Mass., 170 Summer St., S. I. Carpenter.

TERMS OF SUBSCRIPTION.

	Per Year.	Per Copy.
United States, Canada and Mexico	$2.00	20 cents.
Other countries in Postal Union	2.50	25 cents

Entered at New York Post Office as second-class matter.

Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

FOR the third time a President of the United States has fallen by an assassin's bullet. For the first time, however, has this act been inspired by the spirit of pure and unadulterated anarchy. The condition is one of tremendous importance to the people of the country. The blow was not struck at William McKinley the man, but at William McKinley, the President. It was not struck at the individual but at our system of government, at our entire social state. Precious as is human life and valuable as were the life and services of the late President, this act was more than the taking of a life. It was in spirit an assault upon the life and liberties of every man, woman and child who calls this country his own. It was a blow at the very existence of this republic, founded in spirit by the pioneers and colonists of the sixteenth, seventeenth, and eighteenth centuries, born in the struggle of 1776-81, guided and nurtured through the years of the nineteenth century by the wise patriotism and counsel of our early presidents and statesmen, born again in the last great struggle for existence in 1861-65, and then with the question of the union settled forever, gathering strength with the years until the century was rounded out; and now in the opening years of the twentieth century we are attacked by one who acts not for himself, but as the agent of a class whose gospel is murder, and who are absolutely foreign to our soil, institutions and spirit, and who have, indeed, nothing in common with the rest of organized and social humanity.

The blow has fallen and President McKinley is dead, indeed, but the purpose of the murderer and of those in whose name he acts fails most utterly. Theodore Roosevelt becomes the twenty-fifth President of the United States, and constitutional government will go on without halting or stay.

The loss to our nation is, however, none the less great. President McKinley as a man and as a President was of a type which we can ill afford to lose. His was an earnest patriotism which saw for the United States a future of ever widening and deepening influence, and with bold, persistent and patient purpose he labored to shape policies toward his ideal. During the first administration of President McKinley the United States awoke to a realization of her strength and position as a world power. The acceptance of a duty brought with it the extension of our territory and interests far beyond the two oceans between which they formerly lay. Wide as was our horizon before, it has now expanded and we must accept and fulfil the duties which these wider relations involve. No one had a juster grasp or a deeper comprehension of these wider duties and relations than did President McKinley, the man at the helm during the development of this newly awakened spirit of growth and expansion.

Quoting from the spirit of his last speech at Buffalo, his ideals, however, were the victories of peace and friendly rivalry, and not those of war. His wish was for the largest measure of peace, happiness and prosperity over the whole earth, and in which the United States should stand in the front rank in power, influence and prestige.

In the same speech extended reference was made to the maritime interests of the country, and to the part which they should play in her widening influence and power. President McKinley was an earnest believer in the upbuilding of the merchant marine, and in some just arrangement which should induce capital to seek investment here, and which should remove from

us the reproach of a merchant marine so absolutely insignificant in comparison with our commerce and with our position among the nations of the earth.

The hand of the assassin has removed from us the aid of his counsel and influence in furthering this end, and such duty among others is handed over to his successor. The previous record of President Roosevelt, as well as his earnest words concerning his policy, give us the right to expect that his administration will labor earnestly and faithfully toward this object, the achievement of a purpose so near to the heart of the late President.

Though the work of President McKinley indeed is done, and the purposes so near to his heart are thus left to others to carry on, his influence and his memory we have as a lasting heritage, and his place in the love and honor of his countrymen is safe.

WE wish to call to the attention of sea going engineers and of all who are or have been concerned with the operation, management or repair of marine machinery, to the series of articles now running in our columns on break downs and emergency repairs. These articles are proving of great value and interest, and we wish to enlist the widest support in their continuance. We are sure that those who have had practical experience with these matters will be able to recall some experience which would be of interest and value to their fellow workers, and we cordially invite the fullest coöperation in making this feature of our columns one of special value to every practical engineer. It is, of course, not so commonly that break downs and repairs of an entirely unusual and startling nature are met with. After all familiarity with the most probable or common break downs and their repair is of more value than a knowledge of the possibilities involved in occasional rare experiences, although the latter have, of course, their own special interest and value. Let none hesitate, therefore, because his experience has not been something startling or different from that of his fellows. All such experiences contain some element of peculiarity, and in all may be found some item of instruction. We again ask, therefore, the coöperation of those whose experiences in these lines have been of aid to themselves. They will certainly be in no less degree of aid to others.

THE day of the sailing vessel has by no means gone by, witness the splendid ships which have been built in the past few years on the Maine coast, as well as the continued popularity of the fore and aft rigged or schooner type of craft. On another page we describe a recent design made for a seven masted schooner which shows how far some of the modern designs have wandered from the old and conventional three masted schooner type. In common with all craft engaged in the maritime carrying trade there has been an increasing demand for larger sizes of sailing craft. It is a well-known fact that operating expenses increase more slowly than carrying capacity, and hence that the large ship will be more economical than the small one. To meet this demand for increasing size, and with this to maintain the same type of rig, has come of necessity a multiplication of masts. The individual masts, however, are not especially larger than in smaller and shorter types, and the sails which they can carry are, therefore, of no great difference in size. It thus results that while the vessel has increased in size in all three dimensions, the sail area has only increased proportionately in one dimension—that of length. It must follow that this extension of sail area in so much less proportion than that of displacement must react disadvantageously on the speed, and in fact no very great speed can be expected from vessels of this size rigged with sails only. The problem of speed with sails depends on getting a suitable area in proportion to the size, and as the sizes grow to these extremes this is realized with increasing difficulty. This by no means proves, however, that the large slow sailing vessel may not have her uses. It is often a difficult question to determine in the balance of considerations, which will be the cheaper of the two: a steamer with more speed, more trips per year, more certainty and regularity, but with higher first cost and operating expenses, or a sailing ship with slower speed, less carrying capacity per year, some uncertainty and irregularity in movement, but lower first cost and expense of operation. It is not a problem which can be solved off-hand, or to which in any given case a definite answer can be made without a most careful study of the various circumstances of the case. With certain classes of freight the sailing craft is out of the question. With others it may still have a fair field of usefulness, and within this field it seems likely to hold its own.

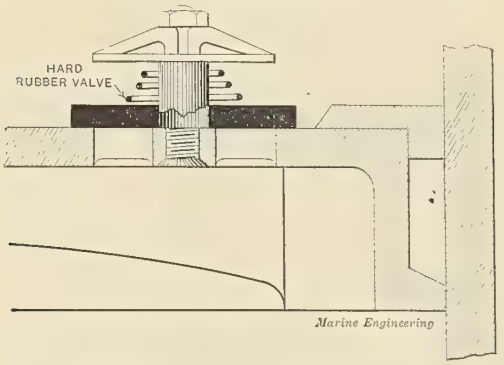
THE CONTEST FOR THE PRIZES.

All articles intended for competition for the two prizes of $15 and $10 each, mentioned in our advertising pages, must be sent in promptly, as the contest will close on December 31.

All articles published will be paid for at the regular rates. The best and the next best will draw the prizes in addition.

A Broken Air Pump Valve.

The United States steamship P——— is a twin screw protected cruiser, having horizontal triple expansion engines. The air pumps are independent, and operated by compound steam cylinders. In order to get them under the protective deck the air cylinders were made vertical, and the steam cylinders put at a slight angle from the horizontal. The pump piston was operated through the medium of a crank shaft, and to give a more uniform motion a large fly wheel was fitted. A more troublesome design could hardly have been concocted, as the pumps were a constant source of annoyance. If they were not driven over ninety revolutions per minute they had a habit of stopping short without a moment's notice. Any engineer who has had an air pump stop on his watch knows that it is not the most pleasant thing he ever experienced. While coming up from Panama to Acapulco I had the midwatch for the trip. Upon relieving the junior assistant at midnight of the second day out, he reported to me that there was a peculiar knocking sound in the



REPAIRS TO BROKEN STUD IN BUCKET VALVE.

forward air cylinder of the starboard air pump. To a man just aroused from a restless sleep in a hot stateroom this was not very cheering information, and I am afraid that I did not say "I will relieve you, sir," in a very agreeable tone. I watched the pump very closely and observed that the knocking only occurred at the top of the stroke, and that it was more severe at intervals. Finally the knocking became continuous, and as the vacuum had fallen somewhat, I decided to shut down the starboard main engine, and investigate. After obtaining the permission of the officer of the deck, the starboard engine and air pump were stopped, and we proceeded under the port engine.

Luckily the air pump barrel was provided with a 10 inch manhole plate. The engine was jacked around until the top of the air pump bucket came just a little below the manhole. Upon removing the cover, the cause of the trouble was at once apparent. One of the bucket valve guard studs had broken off about 3-4 of an inch above the top of the bucket, leaving a rough fracture. The broken valve guard and the hard rubber valve had been rattling round loose at each stroke of the pump. Fortunately none of the other valve guards had been injured. The accompanying sketch will illustrate where the fracture occurred.

By feeling through the valve gratings it was ascertained that the stud had been screwed into place and then riveted over. This, of course, prevented the cutting out of the broken piece without removing the entire piston, an utter impossibility without dismantling the whole pump and causing a great deal of delay. Eventually we decided to simply block off this valve opening by bolting a spare rubber valve over the holes in the bucket. This was soon accomplished by drilling two holes through the rubber valve and fastening it securely in place by two 1-2 inch bolts with their heads set up on washers, each spanning two of the gratings in the valve space. As there were six valves in each bucket the blanking off of one valve opening did not make any material difference with the vacuum thereafter.

An examination of the broken stud disclosed the fact that it was made of ordinary cast brass and that the fracture had occurred where a flaw had previously existed. The lesson to be learned from this mishap is that studs for bucket valves should always be made of either rolled Tobin or manganese bronze.

Ex-Naval Engineer.

Proving Lamination in a Boiler Plate.

I had been a marine engineer for many years, and when our company gave the contract for two new ships I was sent to the rolling mill as inspector of material for the hulls and boilers. When I first started out on my new duties I confess I did not have the confidence in myself which I acquired after several months' experience with several pretty sharp mill superintendents; but after a while I could tell the difference between basic and acid steel, and could talk understandingly of snakes, laminations, sand or scale marks, scabs, pits and defects generally, and was considered an expert with a slide rule or Thatcher calculating machine.

One day when I condemned a large steel furnace plate for being laminated I simply brought the whole mill down upon me, so to speak. Even the roller, who had occasionally condescended to accept one of my cigars, looked at me with pity. "A laminated steel plate! Nonsense! That little crack which you see on the edge of that plate was caused by being rubbed up by the mill housing and rolled under on the back pass of the rolls, and will shear out," said the superintendent. I told him my specifications were very plain and I would be obliged to reject the plate, at which he became angry, and went to headquarters making remarks in an undertone, which, to say the least, were not very complimentary, and it was not long before I was surrounded by all the steel experts of the establishment. After I had listened to all sorts of arguments, until life had commenced to be a burden, I asked the superintendent if he would allow me to prove to him that I

was right. He was magnanimous enough to give me this permission to do so, providing I would be responsible for the value of the plate if I did not substantiate my side of the point in question. I at once had some holes punched along the edge of the plate where the cracks appeared, and drove some rivets in the holes; I then had the plate taken to a forge and placed over a hot fire while a stream of cold water was allowed to play on the opposite side. These were the conditions in an exaggerated form to which the plate would be subjected if incorporated in a boiler. It was not long before a bulge commenced to develop on the side next to the fire, while the side on which the water was playing remained quite smooth. After the bulge was extended about an inch I looked around for some of my friends to ask them their opinion regarding the lamination of steel plates, but they had all disappeared.

One day the superintendent asked me how I happened to think of that method for proving them wrong, and I told him it was only a part of the experience of an engineer who constantly met all kinds of problems in boilers, and I had reasoned that if the ingot from which the plate had been rolled was not perfect, that it contained dirt or other foreign matter or had shrinkage cracks, the plate would not be perfect, no matter how much it was rolled. I had judged that the plate in question was rolled from a slab made from the top of an ingot, although it is not customary in some mills to use the top for boiler plates, the center being considered the best. He agreed with me.

Boiler Plate.

Repairs to a Low Pressure Piston.

The steamship *San Juan*, on the San Francisco-Panama run, during the year 1886, had a very disagreeable slamming noise in her low pressure cylinder, and for a number of months all attempts to locate it failed.

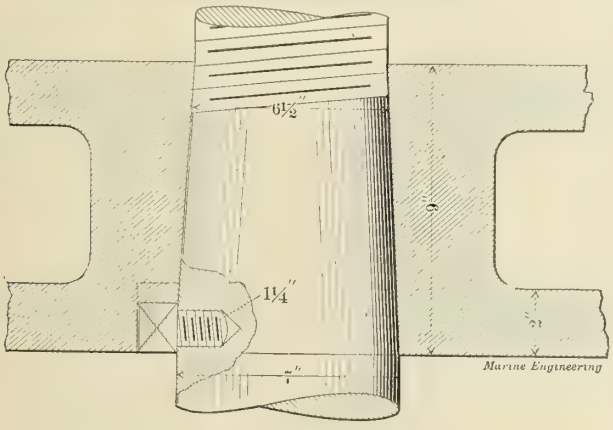


FIG. 1.

Repeatedly the piston ring was set out, the piston nut tried, crosshead slippers lined up, but the slamming noise remained. One day in Panama Bay the piston was taken off the rod (it had been off several times before), and it was found that it had been kept from hugging the taper by the dowel pin, as shown in Fig. 1. The dowel pin slot was cut 1-2 inch deeper and the piston put on the rod again. For setting up the nut a three ton chain tackle was used, one hook in the eye of a wrench handle which reached outside the cylinder flange, the other hook anchored to a strong back across the engine room door. After the piston nut had been tightened to the extent of six men pulling, a luff tackle was fastened to the same strong back and to the hauling part of the chain tackle, six men again pulling on the luff, one man hitting the end of the wrench and another hitting top of the piston every

FIG. 2.

time the six men jerked. After considerable pulling and sledging all six went down in a heap, falling to the grating, the man with the sledge at the wrench handle nearly cutting his feet off. On examination it was found that the piston had broken, or rather, cracked, as shown in Fig. 2. A consultation and examination was then held, and it was decided that the piston had been cracked ever since the noise first started, and to patch it as shown in Figs. 3 and 4. Instead of taking

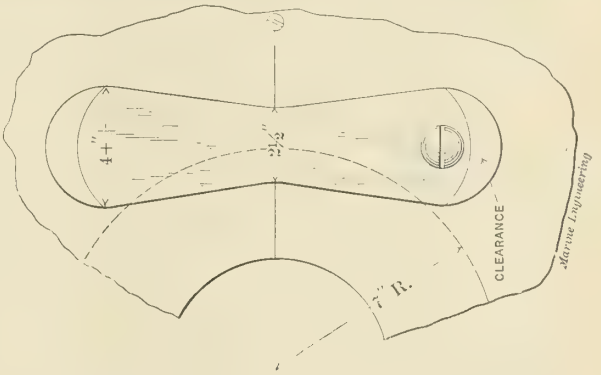


FIG. 3.

it off again, it was also decided to do the job with piston in place, going into the cylinder through bottom snifter and working overhead. A template was made and the three steel patches shaped to it. The template, heated red hot, was laid on a piece of 1-8 inch sheet steel, scribed all around, while hot, and another template worked out to the scribe lines. The piston was then drilled and chipped across the cracks to this last template, and the patches heated and put in place. They were afterward checked with screws as shown.

The job required forty-six hours continuous work of half-hour shifts. The patches were made ashore in the meantime, and the whole job proved a success. The ship went home on about fifty-two turns, her usual speed being about sixty, and then had a new piston

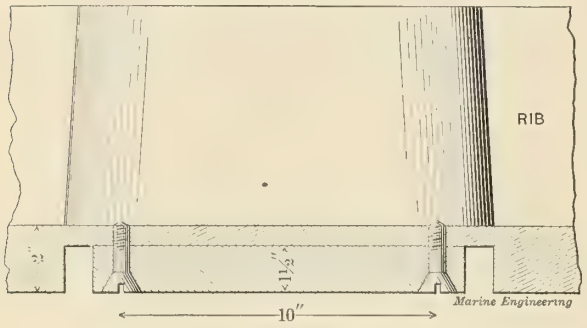


FIG. 4.

fitted. The low pressure piston did not slam on the way home, its nut having been set up as tight as a 20 pound sledge at the end of the same wrench would drive it, a line to keep it from jumping merely, instead of the chain tackle to haul being used. H. L.

Emergency Circulating Pump.

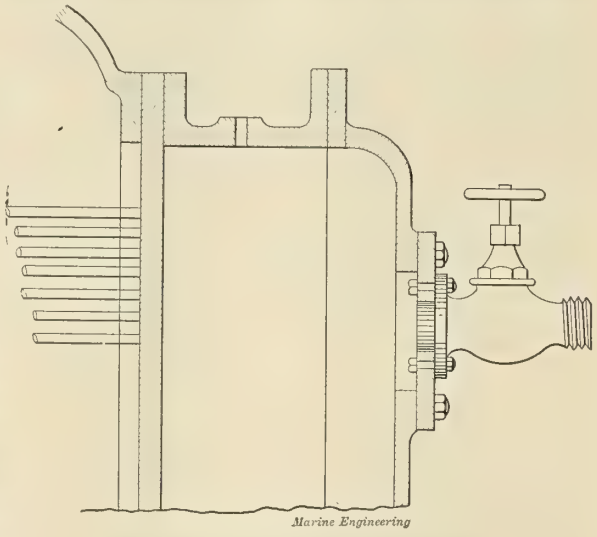
Editor of Marine Engineering:

I have carefully read the various accounts of "Mishap" in the columns of your valuable journal, and have gained a great deal of information therefrom. While not a seagoing engineer myself, my connection with a large repair shop, doing a great deal of marine work, brings to my notice a great number of "mishaps" to marine machinery. One of the most interesting of these was an accident which occurred to the circulating pump on a 2,500 ton steamship. The ship in question was the *M*——, an American built steamer about five years old. She had a triple expansion engine of excellent design, capable of developing about 2,000 horse power at full speed. The main condenser was built in and formed a part of the framing of the engine, as is usual with such engines. The air pump and circulating pump were both independent of the main engine, and of each other. The circulating pump was of the ordinary centrifugal type, being driven by a single cylinder vertical engine, 8 inches in diameter by 8 inches stroke. In common with many other vessels no provision was made for circulating the water through the condenser in case of the breakdown of the circulating pump. Accidents so rarely happen which entirely cripple the circulating pump that no attention had been given by the designers of the machinery to guard against such an emergency. The condenser was not even provided with an arrangement for running as a jet condenser.

On the occasion in question, while the *M*—— was on a voyage from Honolulu to San Francisco, when about 500 miles from the latter place, the engineer on watch at the time noticed the needle on the vacuum gauge rapidly falling, which was of course at once accompanied by the slapping of the low pressure slide valve and the slowing down of the main engine.

Rushing over to the circulating pump engine throttle he opened it wide, but to his dismay the engine would not move. He therefore shut down the main engine and began investigating the cause of the trouble with the circulating pump. This was soon discovered—the crank pin had broken in two pieces, about one inch from the after crank web. The Chief Engineer was called, and after a few moments consultation it was decided that nothing could be done to repair the broken crank pin. The question then was, what could be done? There they were rolling helplessly in the trough of the sea with no sail power, and the chances of being picked up by another vessel very slight. The chief engineer was a very resourceful man, and it was not long before he decided to try a scheme which he hoped would be successful. The plan was as follows:—

Each water chest bonnet was provided, as is customary, with several hand hole plates for the purpose



FIRE HOSE CONNECTION TO CONDENSER.

of examining the tube ends without removing the bonnet. Two of these at the end where the circulating water enters the condenser, were removed and taken to a drill press. In the center of each plate a 2 1-2 inch hole was cut by drilling a lot of 1-4 inch holes around the circumference. The hose connections on the fire main were stop valves flanged on the end which bolted to the main, and on the other ends there were screw hose connections. Blank flanges were put on the fire main after these valves were taken off. Bolt holes were then laid off in the hand hole covers to correspond with those in the flanges of the valves. The covers, after the valves had been bolted to them, were replaced, the joints between the valves and covers having been made with two thicknesses of ordinary sheet rubber packing.

The ship was provided with a duplex pump 14 inches by 8 1-2 inches by 12 inches, which was used principally for fire purposes. Two lengths of hose were gotten out and connected up between the two remaining hose connections and the valves on the condenser. The following sketch will illustrate the method of attachment of the valves.

The fire pump was then started, and with the two 2½ inch streams running through the condenser it

was found that at a moderate speed of the main engine a vacuum of about 20 inches could be maintained.

The total time occupied in connecting these valves was a little less than three hours. The vessel came into San Francisco at about a 7 knot speed, the total delay on account of the accident being only one day. Were it not for the resourcefulness of the chief engineer, it is difficult to surmise what the consequences of this mishap would have been. Respectfully,

James Wallace.

San Francisco, Cal., Sept. 3, 1901.

Boiler Repairs.

Editor of Marine Engineering:

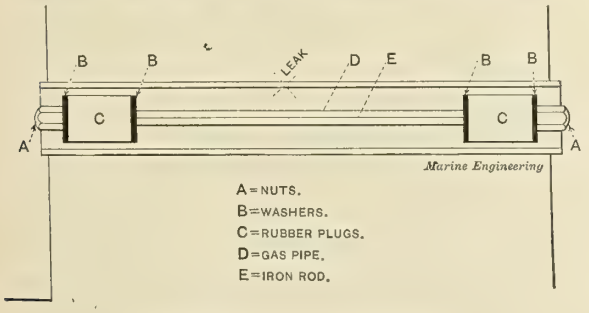
I am a very interested reader of Marine Engineering, and the contributions of "Stories of Trouble in Breakdowns" reminds me of some experiences of mine while for two years a cadet on the United States steamship *E*——.

In the fall of 189— the ship sailed from Funchal, Madeira, homeward bound to Boston after a summer cruise in foreign waters. Our boilers, eight in number, were of the Scotch type, and so old and full of leaky tubes that we steamed little, relying wholly on our sail power, as we were bark rigged. On September 23d, when just north of the Bermudas, we met the full blow of a West Indian hurricane, and a frantic effort to run out of it resulted in a constant repairing of tubes, tube sheet, etc. So thinking, perhaps, some readers of your interesting magazine would like to see how I made repairs I send you an account of them. Matt. W. Colquhoun.

Boston, Mass.

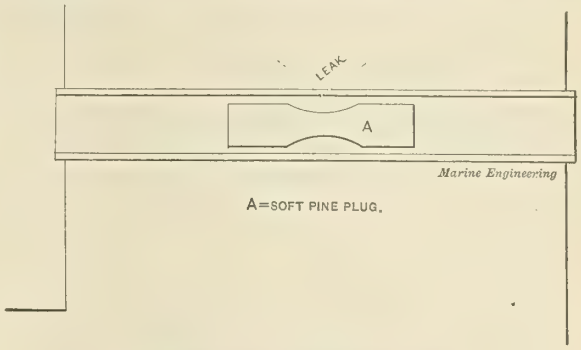
TO REPAIR A LEAKY TUBE WHILE UNDER WAY.

First fit an iron rod as long as the tube with a thread on each end. Then, starting at left hand of rod in illustration, screw on a nut, then put on a washer just a little smaller than tube; then a plug of rubber, then another washer; now put on a piece of piping of such length that after similar fittings are placed on the other end the whole thing will be about the length of tube. The other end is then fitted like the first, and the piece of apparatus can then be



RUBBER PLUG FOR BOILER TUBE.

pushed into the tube from the front, and as you then set up on the nuts the rubber will be so pressed as to stop up the tube. The above form of tube stopper is good, but cannot be relied upon, as the fire burns the rubber after being in a short time and leaking is likely to set in, especially when under heavy pressure, but in a case of emergency it may be very useful. Another method is like this illustration. A soft pine

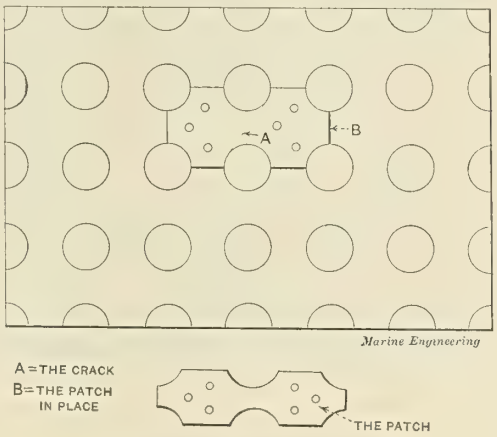


WOODEN PLUG FOR BOILER TUBE.

plug, shaped as in the figure, may be pushed into the tube until it covers the location of the leak. Steam and water from the leak will then cause the hollow part and ends to swell and stop the leak.

PATCH FOR CRACK IN TUBE SHEET.

The way I would repair a crack in the tube sheet is shown in this illustration. I would take a patch and make it so it would fit over the crack and be-



PATCHED BOILER TUBE SHEET.

tween the tubes neatly. Drill holes (not very large) in the patch and tube sheets, so as to make it fast by, and after putting on red lead over the crack I would make it fast with tap bolts.

Matt. W. Colquhoun.

Always and Never Maxims.

Editor of Marine Engineering:

For the help and guidance of your younger readers I beg to send you the following "always" and "never" maxims, trusting these little rules will be of as much service to others as they have been to me.

Ancient Mariner.

Always.

—Remember your responsibility when on watch, eternal vigilance and observation is the price of success.

—Take pride in the cleanliness of the engine department, avoid defacing paint work.

—Be careful in the use of stores, careless use of oi

aside from the direct waste, soils the engine and department and fouls the bilge.

—Remember that noise never adds to the efficiency of the department.

—Make yourself acquainted with the pipe system at the earliest opportunity.

—When cleaning about the engine take precaution to prevent emery or dirt from getting into oil holes or in other ways reaching the slides or journals.

—Remember that many a piston or valve rod packing has been burnt out and the rod more or less scored by setting up too hard.

—Remember that the bilge is not a receptacle for refuse of any kind, especially dirty waste or soapy water, the former is about the best known substance to clog the bilge suction pipes, and the latter has hardly a superior for rendering the bilge slimy and offensive.

—When through using any valve communicating with the sea, *close it.*

—Be careful in the use of cylinder oil, any excess fouls condenser and boilers.

—Remember that when at sea we have not a reservoir of fresh water to draw from, any waste of fresh water involves extra labor, coal, extra watches, scaling of boiler and evaporator, and extra labor in cleaning.

Never.

—Question or fail to obey an order promptly.

—When off watch interfere or meddle with any valves or appurtances in the engine department.

—Fail to report at once whenever you discover anything wrong in the department, especially when under steam.

—Leave your post of duty until regularly relieved.

—Take it for granted that everything is all right: *Be sure* of it from your own personal knowledge.

—Let steam into a main or auxiliary line without first draining any accumulated water.

—Open a steam stop or safety valve suddenly.

—Start a pump until you are positive that all valves, exhaust suction and delivery are properly set.

—Let up on a gauge glass packing without first closing both supply valves to water column.

—Open the drain cocks on the bottom of steam gauges, as subjecting the springs to rapid changes of temperature soon renders them unreliable.

—Feed a boiler rapidly or in large quantities at a time, especially if the feed is cold.

—When under steam change the setting of valves without proper authority, or immediately report what you have done and why.

—Leave a furnace door open longer than is necessary, or put on a large amount of coal at once if you wish to hold steam and avoid leaky boilers.

The last number of the Power Quarterly, issued by the Power Publishing Co., World building, New York city, is the Pan-American edition. It is the same size as Marine Engineering, and contains eighty pages and cover, of which sixty-eight pages are text. Practically all of the exhibits, which include specialties connected with steam and electrical engineering, are illustrated and fully described. To anyone who contemplates visiting the exposition, a copy of this quarterly will be of much value. The price is 25 cents.

CORRESPONDENCE.

Triple Versus Compound Engines.

Editor of Marine Engineering:

Sirs: I was very much interested in P. A. Engineer McAllister's article on the comparative coal economy of the revenue cutters *Calumet* and *Hudson,* and with your comments thereon. I cannot, however, agree to the proposition that the data given warrant the conclusion that the triple expansion engine is more economical under the conditions of that service than the compound. While I am not prepared to assert the superiority of the compound or even claim an equal performance for the older type, I feel that the question cannot be considered settled without further facts. I may briefly state my reasons for this:—

1st. There is nothing to show that the compound engine was a good representative of its type. My own experience would show that for continuous steaming with the size of engine used on these cutters a superiority of about 10 per cent may be expected in the triple when both types are equally well designed.

2d. It seems to me improbable that the engines did the same work. At the probable speed, wave making would form a considerable portion of the total resistance of the vessels. The extra length of the *Hudson* might more than make up for her increased displacement. At best we have no information as to which boat has the greater resistance.

3d. A small difference in the speed at which the service was performed would account for a very considerable increase in power. If the steam pressures were anywhere near the same, I would naturally expect to see more power developed by the *Calumet* than by the *Hudson.*

4th. The skill with which the fires were handled with the vessels at rest would account for a considerable difference. The well known experience of the battle ships off Santiago illustrates this.

I think that the foregoing reasons are enough to show that Mr. McAllister's contribution to our knowledge on the subject, valuable and interesting as such contribution is, cannot be said to have settled the matter definitely. I need only point out that the design of the propellers might account for all of the difference shown.

I have used the compound engine in ferryboats, and may say that I have found it by careful tests, more economical than one triple expansion engine (that of the *Bergen,* whose cylinders are 18 1-2, 27 and 42 inches diameter by 24 inch stroke). There is no question in my mind that for some routes any possible saving by the triple will not pay for the increased cost of its installation where fire tube boilers are used. In a ferryboat the engines on some routes are at rest 60 per cent of the time the boat is on duty, say fifteen hours a day, while the increased radiation due to higher temperature is wasting steam all that time, the engine must be warmed up for every run (or say four times an hour), and the interest account runs along for 24 hours for 365 days in a year.

I hold no brief for the compound, but I do believe that its day is not yet passed for small vessels, intermittently worked. The triple has its mechanical as well as economical advantages, and for some ferry

routes and for such service as I suppose is required of the revenue cutters, it ought to prove superior to the compound.

It would be very gratifying if P. A. Engineer McAllister would kindly give us further information as to the *Hudson* and *Calumet*. His opinion as to the excellence of the designs of their hulls, engines and propellers and any data thereon, his views as to the comparative efficiency of the engine and boiler room staffs and the reputations of the boats for speed in their ordinary service, would give, I feel, valuable information in addition to the interesting facts in his paper. I only voice the feeling of all engineers interested in this subject in thanking him for what he has already given us, and like Oliver Twist, in asking for more. What we all want is knowledge based on facts such as he has given us, and not theories evolved *a priori*.

Yours truly,

E. A. Stevens.

Lloyd's Register Shipbuilding Returns.—On June 30, 1901. 442 merchant vessels of 1,300,179 gross tons were under construction in the United Kingdom. This is a slight reduction in the tonnage reported three months ago, and a decrease of 101,000 tons as compared with the highest record, December, 1898.

British Destroyer Sunk.—The British torpedo boat destroyer *Cobra*, the second to be fitted with Parson's steam turbines, foundered in the North Sea, on September 18th, while on her way from the builders' yard on the Tyne to Portsmouth. It is reported that the wreck was due to rough weather, which carried the boat off her course and on the rocks. Out of a crew of sixty-nine men only twelve were rescued.

Wreck of the Viper.

The torpedo boat destroyer *Viper*, the first of the British fleet to be fitted with steam turbines, was wrecked in the British Channel on August 4th.

At the time the *Viper* was engaged in chasing torpedo boats, a part of the maneuvers, a dense fog settled down, and speed was reduced from 22 knots to 16 knots, while running at this speed she struck on the rocks of the Island of Alderney. Distress signals were fixed, but were not heeded by the other vessels, which supposed them to be part of the maneuvers. The crew attempted to save her, but were compelled to hastily leave in small boats. The racing tide was on the ebb, and at low water the boat broke completely in two. When the tide rose again the forward body floated out and sank at right angles to the after body, which turned turtle and lay in the position shown in the engraving.

TORPEDO BOAT DESTROYER VIPER, DRIVEN BY PARSON'S STEAM TURBINES, WRECKED IN THE BRITISH CHANNEL.

On her official trial the *Viper* made 36.5 knots, and had since been put through a series of tests, first at 18 knots, next 25 knots and finally at 30 knots speed, for drilling her crew and testing her endurance. Competitive efficiency trials were planned with the Thornycroft destroyer, *Albatross*, but as the *Viper* is a total loss these will be run with one of the twelve other turbine destroyers now being built. The above engraving is reproduced from *Navy and Army Illustrated*.

Boiler Explosion. — The new steamboat *City of Trenton* was destroyed by fire, and many people were killed and injured as a result of the explosion of the port boiler. The steamboat was running on the regular service of the Wilmington Steamboat Co., between Philadelphia and Trenton.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MC ALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER II.

After the Professor had washed up and changed his clothes that evening he went to dinner, where he was introduced to some of the passengers. Dinner being over, they all adjourned to the upper deck and sat around engaged in conversation until four bells struck, when the Professor, feeling rather tired from his first day's experiences, decided to "turn in." The evening was cool, there being a light air blowing and a gentle swell, and as he rolled up in his blanket he concluded that going to sea had some pleasant features after all.

The next morning he was called early; getting up at once and dressing, he went out on deck and found the weather conditions about as they were the night before. The salt air had given him a good appetite, and after a hearty breakfast he went to his room, donned his overalls, and at 8.30 was ready for another day of observations below. Going at once to the fireroom he found an entirely different lot of men on watch from those he had met the afternoon before. However, all hands had heard that the chief's brother was on board, so there was no surprise expressed when he came in and introduced himself to the water tender. He gazed respectfully up at the gauge glass which had broken the day before, and as he walked around the fireroom, gave it a wide berth. A big, brawny fireman was cleaning a fire in one of the port boilers, and the Professor could not but look with admiration at the fortitude of the man as he wielded a heavy slice bar and gazed fearlessly in at the white hot clinkers which he was prying off the bars. The heat was so intense that the Professor could scarcely believe that a human being could endure it, let alone performing the hardest kind of work under its fiery glare. This led the Professor to soliloquize on the difficulties that would be encountered in adapting mechanical stokers for marine work. Considering the suffering that firemen now have to undergo, he wondered that more attention was not given to this important matter by inventors.

After the fire had been cleaned and filled up with fresh coal the man, almost exhausted, sat down on a bucket under the mouth of the ventilator. The Professor stepped up to him and expressed his sympathy, but was greatly surprised to hear the fireman reply: "Ah! dat aint nothing, wait till we get down in the tropics, where it's hot for sure." And this for forty dollars a month, thought the Professor. How can they get men to do it?

His attention was next called to a grimy looking individual who was puffing and sweating as he shoved a large bucket of coal suspended from a trolley over head, through the bunker door and dumped its contents on the fireroom floor. After the man had gone back into the bunker the Professor, somewhat timidly, started in to see where he had gone. As he stepped through the bunker door he found himself in absolute and dense darkness, and as the bunker he was in was right alongside of the boilers, the heat was, of course, intense. Added to this the air was filled with a stifling coal dust. After becoming somewhat accustomed to the darkness he saw at what seemed a great distance off, a faint, flickering light. Groping his way along and stumbling over lumps of coal he finally reached the after end of the bunker, where he found the coal passer diligently shoveling coal into the bucket and whistling away as if his was the happiest lot on earth. The man was so black that he could scarcely be discerned from the surrounding pall of darkness; to add to the dust the petticoat lamp suspended from a beam overhead was emitting clouds of vile smoke from the lard oil which it was burning. The Professor asked the coal passer how he could live and work in such a stifling atmosphere. He was again greatly surprised at the rather cheerful answer that "This is dead easy to what it will be when it gets rough and I have to push coal out of the 'thwartship bunkers." Well, thought the Professor, human happiness is, after all, only a matter of comparison. His lungs having by this time become, as he thought, about filled with coal dust, he made a hasty exit, and found the fireroom much more habitable than it seemed before he went into the coal bunker. This experience set the Professor to reasoning why ship designers could not arrange coal bunkers so that they would be more accessible, or so that a good proportion of the coal would, by the force of gravity, run into the fireroom. He could also see no good reason why ventilating pipes should not be fitted to coal bunkers, which would not only help to carry off the smothering coal dust, but would at the same time tend to lessen the danger of spontaneous combustion. Another improvement which he thought should be made was to install heavily protected incandescent bunker lights, or arrange for portable lights, and thus do away with the loathsome smoke from oil lamps. Such improvements would add slightly to the first cost, but taking into consideration the decreased hardships on the men, he concluded that it ought to pay in the quicker and better work which would result. It was gradually dawning on the scientific man that ship designers are too often men who are so absorbed in theories that they seem to lose sight of the fact that the success of the ships and machinery of their creation depends as much or more upon the men who run them, than it does upon the excellence of the design in itself. With this thought in mind he concluded that increased attention ought to be given to making things more comfortable for these "toilers of the deep."

At this point a shrill whistle somewhat startled the Professor, and as he turned around quickly he saw the water tender rush over to the engine room speaking tube and shout: "Aye, aye, sir!" What was said by the engineer of the watch could not be heard by any one except the water tender, but there was a faint suspicion of blue air around the mouthpiece, after the water tender had left it, and made a dive for the check valve on the after boilers. This haste on the part of the "boss of the fireroom," and the dull thumping sounds coming from the engine roon caused the Professor to look anxiously about. Looking up at the water gauge glasses on the two after boilers he saw that the water was away up to the top, while on the forward boilers there was only two or three inches of water at the bottom of the glasses. The water tender had been in a

trance; as a result of the high water the after boilers had foamed, and the water being carried over with the steam, had caused the hammering in the cylinders, much to the disgust of the first assistant on watch. With the after-checks shut off and all the feed put on the forward boilers, the water soon resumed its normal level in all four boilers, and the foaming ceased. Although the water had been too high in the after gauge glasses, the Professor could see no reason for the foaming until he noticed the position of the glass relative to the diameter of the boiler. He saw at a glance that whoever had designed the boilers had fallen into the common error of robbing the steam-room to gain heating surface. His brother, the chief, came into the fireroom at this time, and, figuratively speaking, jumped onto the poor water tender with both feet. Turning to the Professor, he said: "Well, how do *you* account for this foaming?" This gave the Professor an opportunity to explain that the boilers did not have sufficient steam room, and that the foaming was due more to that fact than to the carelessness of the water tender. Continuing, he said that boilers should have steam space sufficient to give a "life of steam" of not less than twenty-five seconds. As this seemed too abstruse a statement, he continued by saying that a good rule of thumb was never to have the highest heating surface much less than one-third of the diameter from the top of the boiler. "That may be so," said the chief, "as the highest heating surface in these boilers is much nearer the top than that." Muttering to himself, and with a warning glance at the water tender, the chief then went aft and left the Professor to his further observations.

He had been keeping an eye on the water tender for some time, but had not observed him try the gauge cocks, although he, of course, looked at the glass gauges quite frequently. He finally asked him why he did not try the gauge cocks occasionally as a check on the water level shown in the glasses. He was answered rather shortly: "They won't work." Upon closer examination he saw that they were of the screw pattern, and that they were fitted with long rods which actuated the gauge cocks by means of bevel gear wheels. The Professor tried to open one, but could not budge it. The water tender explained to him that they had not been used for months, and that even when they were thoroughly overhauled it was very difficult to operate them. This somewhat astonished the Professor to think that the gauge glasses had been alone depended on, and he did not hesitate to tell the man that it was very dangerous to rely on one method only of ascertaining the water level. He also told him that, in his opinion gauge cocks should be made as simple as possible, and that the ordinary weighted cocks, such as is used on stationary boilers, would be more reliable, as they are bound to work by simply raising the weights with a forked rod.

As the boilers were not steaming very well, the engineer ordered the water tender to have the tubes of one of the after-boilers swept. The connection doors were raised, and one man proceeded leisurely to blow out the tubes with the steam tube cleaner. He went at it so slowly that the Professor spoke to the water tender to hurry the man, and explained that keeping the connection doors open so long not only kept the steam down, but the rush of cold air on the hot tube sheets was very bad and might start the tube ends leaking. He said that this was such an important matter that it seemed to him that two tube cleaners should be fitted and then have two men put on one nest of tubes at a time, in order to keep the doors open as short a time as possible. The operation of slicing the fires next absorbed the Professor's attention, and the way the men wielded the heavy slice bars excited his admiration. He could now readily see how useless it is to make the grates over six feet in length, as he observed that it took a strong man to shake up the backs of even a six-foot fire. In slicing the fires he noticed that the men put the slice bar through the small doors provided for that purpose in the furnace doors. Even if the furnace doors were opened, however, he could see that it was impossible to work the corners of the fires alongside of the furnace fronts. He concluded that it would be a good idea to fit slice bar doors or flaps at the level of the grate bars in each side of the furnace front, so that the corners of the fire could be properly sliced.

It was now six bells, and word was received from the engine room to hoist ashes. The men went at it in the old-fashioned way; one of the firemen was sent on deck to run the ash hoister, three men were detailed from the deck force to dump the buckets into the ash shute, and below it took all hands except the water tender to shovel the ashes under the ventilator and to fill the buckets. It took fully fifteen minutes to get out the ashes in this manner, and the Professor remarked to the water tender that he had seen trials with an ash ejector where three men had put out the same amount of ashes in half the time. Taking into consideration the fact that as everybody was engaged in handling ashes, and consequently could not work the fires, and the amount of steam used by the hoisting engine, the Professor was of the opinion that the extra amount of steam used by the pump connected with the ejector would be more than compensated for by the use of this modern appliance.

"Something is burning!" suddenly shouted one of the firemen, and sure enough there was. As the Professor had become so absorbed in his reverie over ash ejectors, he did not notice that he was standing on a hot slice bar until half of the sole on one of his shoes had been ruined, and a large blister raised on the bottom of his foot. The Professor concluded that it was about time to look at his watch, and to his surprise, he found that it was nearly noon. As he had been below nearly an entire watch he thought he had acquired enough experience for one day, and so limped out of the fireroom and went on deck. As he was slowly washing the coal dust out of his hair, eyes, nose and ears, he ruminated over the fact that practical experience, gained by a scalded neck one day and a burned foot the next, not to mention a ruined shoe, was harder to obtain than knowledge from books.

British Pacific Cable.—The bill for the construction of a Pacific cable by the Imperial Government and the Australian Colonies has passed the House of Lords on its final reading.

Repair of the Frame of a Bending Machine.

The frame was broken as shown by the line M N in the figure. The following is a description of the method of repair adopted:

Description.

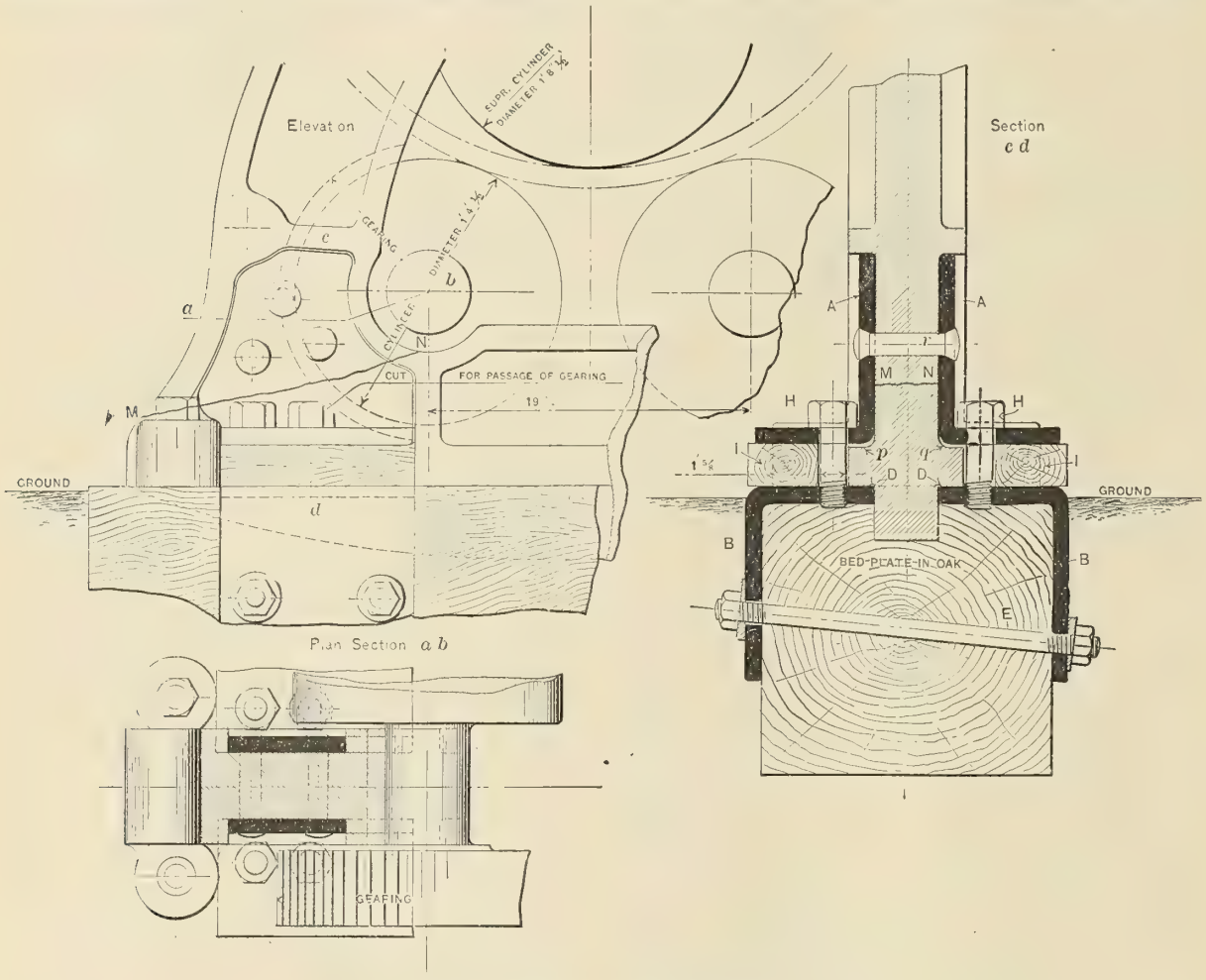
The repair required the following: (1) Two mild steel angles AA, about 1 inch in thickness,, riveted to the upper part of the frame with three 1 7-16 inch rivets *r*.

These rivets are of steel of the mildest possible quality and turned to fit. (2) Two mild steel angles BB, in its true position. Fit these angles on the frame so as to have a little play at *p* and *q* between the base of the angles and the lower flange of the frame.

(2) Mark the holes of rivets *r* on the frame so that there will be sufficient material between them and the line of fracture. Drill these holes in the frame slightly smaller than the true diameter of rivets.

(3) Fit the angles A, one after the other, on the frame and mark the holes for rivets. Drill these as above.

(4) Make and fit the angles B at their place as indicated on the sketch, and drill the holes for bolts F.



REPAIRS MADE ON A BENDING MACHINE.

about 1 inch in thickness, fitted on the angles of the timber which serves as the bedplate of the machine.

The two horizontal flanges of these angles are fitted into grooves made in the wood, and are set under the frame next the central web D.

These two angles are secured together through the wood by two bolts E. These bolts are oblique for greater facility in making the holes in place. (3) Four screws, H, connecting the upper and the lower angles. (4) Two filling pieces of hard wood I.

Method of Making the Repair.

(1) Make the two angles A according to patterns fitted in place, having care to maintain the broken part

(5) Fit the two angles A together with three temporary bolts on the frame and mark the holes of the screws H with great care, considering the very little space available. Next drill these holes.

(6) Fit the upper part of the frame with its angles so that the two parts of the fracture shall be exactly in place.

(7) Mark the holes for the screws H in the angles B.

(8) Dismount for boring and tapping these holes.

(9) Fit the angles B, the frame and the angles A with temporary bolts, put in the screws H and tighten carefully to put the fractured parts well in place. Then fit and tighten the bolts E.

(10) Withdraw one by one the temporary bolts, bore each hole to the diameter of the rivet and put each rivet in place as soon as its hole is bored.

(11) Rivet in place the three rivets *r*.

(12) Tighten hard the screws H with box wrench.

(13) Fit in the filling pieces I.

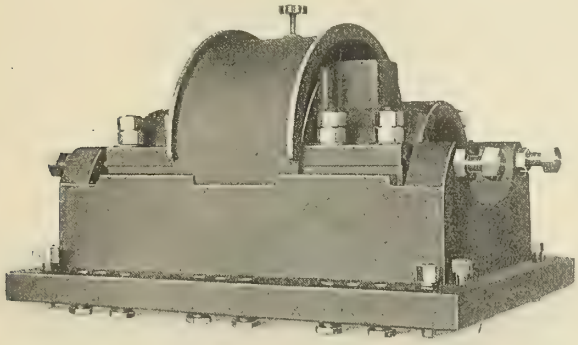
(14) Tighten again the screws H as hard as possible.

This repair was made very carefully, the rivets being made exactly for the holes, and put in place by hammering.

The time required was three days.

Since this was done we have rolled several plates of 1 1-4 inch thickness for marine boilers, and several tubular plates for water-tube boilers of 1 3-32 inch thickness, to a radius of 20 inches.

This work was done with the plates hot. It was, however, very hard on the machine, but the repair held perfectly, and it may be said that the machine is now as strong as before the break. W.



ROLLER THRUST BEARING ASSEMBLED.

ENGINEERING SPECIALTIES.

Patent Roller Thrust Bearings.

The roller thrust bearing made by the Mossberg & Granville Mfg. Co., Providence, R. I., was designed to be used to take end pressure or heavy loads wherever friction enough develops to warrant the application of any bearing, or wherever trouble develops from overloading. It is now used on propeller shafts, worm thrusts, vertical shafts, and in fact, at all places where end thrust develops. Its advantages over the plain bearings are that from 15 to 60 per cent of the energy used in overcoming friction is saved, and the heating of bearing is entirely eliminated. This bearing is designed on the same lines as the cylindrical roller bearing of this firm's manufacture, the only difference being that in the thrust bearing the axis of each roller is at right angles to the axis of the revolving shaft; while in the cylindrical bearings, as applied to lateral pressure, the rolls are parallel to the axis of the shaft. It is therefore evident that in the cylindrical roller bearing all points on the surface of the rolls will move at the same speed, while in the end thrust roller bearing, the speed of any point on the surface of the roller depends upon its distance from the center line of the propeller shaft, those points farthest away having to travel faster than those nearer. This difference in speed is overcome in this bearing by the use of conical rollers, each roller being held in place by a cage, so designed that the axis of each roller points to the axis of the shaft, and if lines representing each side of the roller were continued to the axis of the shaft, each roller would form a perfect cone with its apex at the shaft center line. The bearing surfaces of the two end plates, between which the rollers revolve, are also made to the same angle or taper as the conical rollers, so that there is a perfect and continuous line of contact between the rollers and the thrust discs. The amount of end pressure and the revolutions per minute regulate the length of the line of contact. The greater the pressure and the speed, the longer are the conical rollers. It is found in practice that the Mossberg & Granville end thrust roller bearing will stand a pressure of 4,000 pounds per square inch of the area traveled over by the roller per revolution. The conical roller and the thrust plates of this bearing are made of the finest grade of tool steel, machined, hardened and ground accurately to size. This style of bearing has been successfully applied to steamboat propeller shafts. The steamboat *Squantum*, on the Providence river, owned by the Fall River and Newport Steamboat Co., was fitted with a roller thrust bearing three years ago, and when the bearing was taken apart this spring it did not show any appreciable wear. This would not have been the case had the rollers and bearing surfaces been made of anything but the finest steel, hardened and ground.

ROLLER THRUST BEARING OPENED.

Each of these bearings fitted is designed by the makers in accordance with the required conditions of service.

Improved Pipe Couplings.

Three forms of improved couplings for pipes are shown in the accompanying cuts, all being originated by the patentee, Luther D. Lovekin, Chief Engineer of the New York Shipbuilding Company, Camden, N. J.

In Fig. 1 is shown the type of the *Keystone* coupling, which consists of two cast flanges having a recess to receive the expanded pipe ends, and also a cast packing ring of triangular cross section placed between the pipe ends. The packing ring is provided with circular ribs and arranged in such manner as to firmly engage the expanded pipe ends, making a perfectly tight joint as the bolts are set up. The outer circumference of the packing ring is turned to fit the portion of the flanges against which it bears and thus accurately

maintains the alignment of the flanges and prevents them from bending. No finish is required except spot facing for the bolts, and taking a light cut on that part of the flanges and ring mentioned. The use of this joint eliminates entirely the brazing of pipes and hence any local injury to the metal. The expanding of the pipe ends is very perfectly done by an expanding and flanging machine, which has also been invented and patented by Mr. Lovekin.

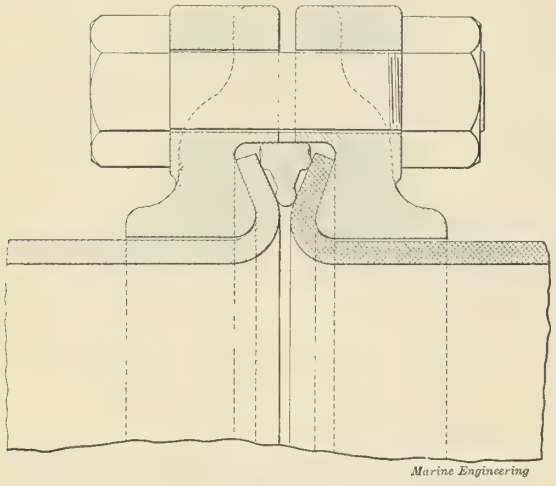


FIG. 1.

Fig. 2 shows a modification of the *Keystone* coupling, employing a packing ring of such shape as to form a continuation of the full area of the pipe in the coupling, thereby giving an unbroken flow, and reducing the resistance to a minimum. No brazing is required in this joint, and a considerable reduction of the pitch circle diameter is obtained, thereby reducing the size and weight of the flanges.

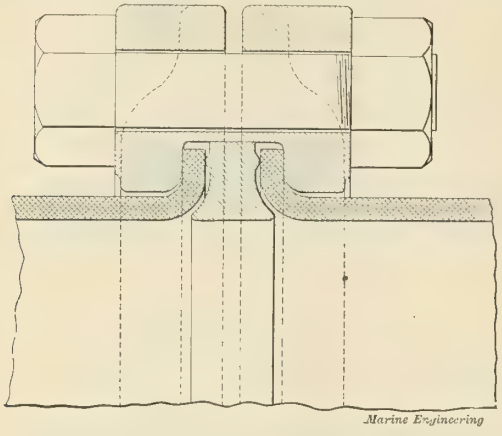


FIG. 2.

Fig. 3 shows a type of coupling in which the packings ordinarily employed, such as rubber and copper gaskets, are dispensed with. One flange is cast with circular ribs, as shown, which bear against the face of the flange opposite, a complete circular metallic contact being formed by the ribs as the bolts are set up. The only finish required on the flange being a light cut on the point of the ribs and the face opposite, on which they bear. This coupling is probably one of the most effective and inexpensive in use, and tests have been made which demonstrate its ability to maintain a perfectly tight joint under a pressure of 2,000 pounds per square inch, and in which the pipe was bulged and ruptured.

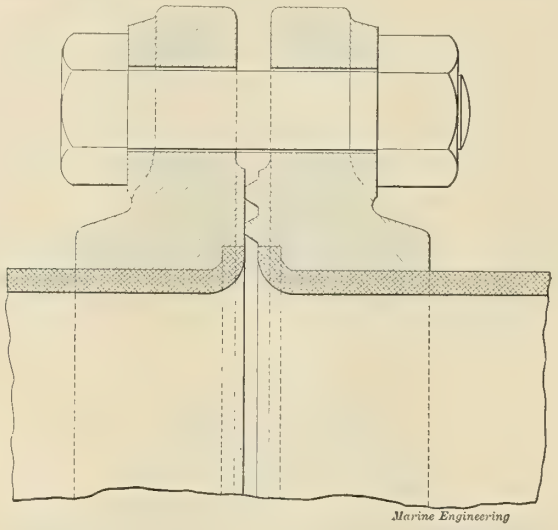


FIG. 3.

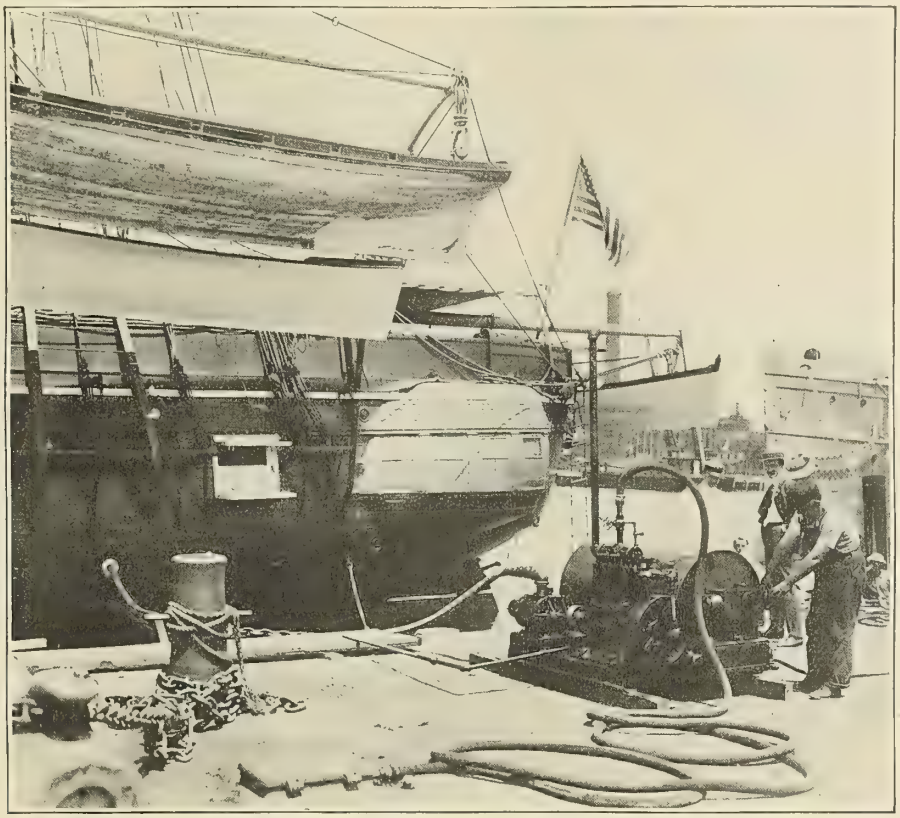
The Clayton Disinfecting System.

The prevalence of the bubonic plague in some of the British colonies aroused the health authorities at the leading English ports to take some precautions to prevent the importation of this disease. Medical investigations have determined beyond question that the rats and other vermin which infest ships in the Oriental trade were extremely dangerous as carriers of plague germs. Accordingly some methods of exterminating these pests were actively sought, and a reliable one was found in the system of the Clayton Fire Extinguishing and Disinfecting Company, of 11 Broadway, New York. This Clayton system is based upon the ordinary methods of sulphur fumigation; the sulphur, however, is burned outside the ship, and the gas pumped in, with the result that a sufficiently strong atmosphere can be obtained within the vessel to extinguish all forms of germ or animal life. Upon being satisfied of this fact the British shipping men took the matter up actively.

The first ship treated by this method was the *Manora*, of the British India Steam Navigation Company's fleet. She had been at her London dock for a week and her officers were quite certain that most of the rats had gone ashore. However, after disinfecting three hundred and one dead rats were found aboard, besides myriads of cockroaches and other insects. There was, of course, some doubt when this work was undertaken whether the cure would not be worse than the disease, and the rats die in inaccessible places. A letter received from the ship's captain, dated at Marseilles two weeks afterwards, showed that the work had been entirely successful. This had been expected because when the ship was opened it was found that every living creature had fled toward the portholes and other

openings to the outside air. This operation was successfully repeated upon many other vessels.

About the middle of July the United States training ship, *Monongahela,* arrived at the Brooklyn Navy Yard after a long cruise. She was so infested with vermin that it might almost be said she was literally alive with them, and existence on her for both officers and men was practically unbearable. The methods employed in England were used on this ship, but in her case the living quarters alone were treated. In the engraving, which shows the stern of the *Monongahela* and the bow of the *Montgomery,* the application of the machine is made clear. The generator was placed upon the dock, and the gas conducted to the vessel, which had been



CLAYTON DISINFECTING SYSTEM USED ON U. S. S. MONONGAHELA.

thoroughly caulked, through an ordinary fire hose. The compressed air plant at the Navy Yard furnished the motive power to drive the pump. The infusion of the gas continued about eight hours. When the hatches were opened and the gas had been pumped out the operation appeared to be entirely successful and within the two weeks during which the *Monongahela* remained at the Navy Yard refitting, not the slightest evidence of the recurrence of the trouble was found. The officers of the ship pronounced the work absolutely effective, and freely expressed the sense of relief which this condition of affairs inspired.

Submarine Boat Adder. — The submarine torpedo boat *Adder* was launched from the Crescent shipyard, Elizabethport, N. J., on July 22d. She is built from plans prepared by the Holland Company, and measures 63 feet 4 inches over all.

TECHNICAL PUBLICATIONS.

How to Become a Good Mechanic, by John Phin, Second edition, re-written and enlarged. Paper covers, pp. 68, size, 5 inches by 7 1-2 inches. Price 25 cents. Industrial Publication Co., New York.

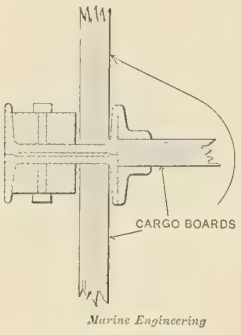
The author of this little book has long been a favorite writer on practical topics for practical men. The first edition of the present work was published nearly twenty years ago, and the present edition has been rewritten in answer to a continued demand for advice and guidance on this topic. Much of the new matter in the present edition deals with the value of technical education to those who desire to become expert and thoroughly successful mechanics. The uses of such education as well as the various means by which it may be obtained are discussed in a clear and interesting manner. Nevertheless, as remarked by the author in his preface, the number of those who desire a sound education and whose only means of obtaining it is through earnest devotion to home study and what may be called self instruction, has also largely increased, and it is largely in the interests of the latter class that the present edition has been issued. In its present form the book is therefore intended as a guide to those who may wish to obtain a practical education either by the assistance of schools, or largely through their own unaided efforts. To this end the book seems well adapted, being written in a clear and instructive style, and it may be recommended cordially to all those who may be interested in the topics of which it treats.

SELECTED MARINE PATENTS.

680,671. SCREW-PROPELLER. Francis W. Brewsters, London, England.

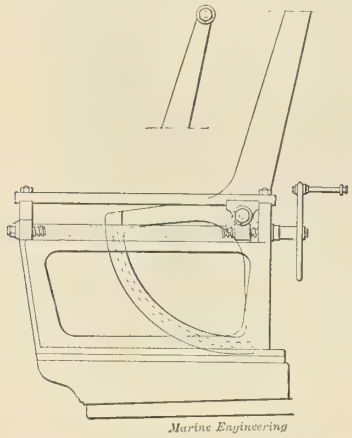
CLAIMS.—In a screw propeller a blade made in the form of a severed loop having its leading and following limbs attached to the boss in helical continuity, so that the limbs will, when rotating, pass through the water in parallel planes, without the one blanketing the other.

680,692. CARGO STEAMER. Henry Burrell, Glasgow, Scotland.



CLAIMS.—In a cargo steamer the combination of hatches with stringer plates, of vertical struts supporting said stringers and located at the four corners of the hatches, and of the sections as shown, made of two channel irons riveted together and backed with angles such that cargo boards may be shipped in to divide the holds of the ship transversely and longitudinally.

680,823. APPARATUS FOR RAISING OR LOWERING SHIP'S BOATS. Axel. Welin, London, England.



CLAIMS.—The combination of a davit, a pivot about which the davit can turn, means for controlling the movements of the pivot, a toothed segment at the lower end of the davit and a rack on which the segment can roll.

681,363. BOAT. Arthur E. Chambers, Kalamazoo, Mich.

CLAIMS.—The combination with ribs and a center strip, of sheet metal skin made in longitudinal strips with their edges joined by double seam and secured to the ribs with clinch nails embraced under the seams.

681,562. DEVICE FOR CLEANING SHIP'S BOTTOMS. James C. Middleton, East Palatka, Fla.

CLAIMS.—A device comprising a flexible tube with glass in the walls at the lower end, and an attachment for a bag-like device which fits over the arms, legs and body of a person such that he can descend through the tube into the bag-like device and work below the surface of the water.

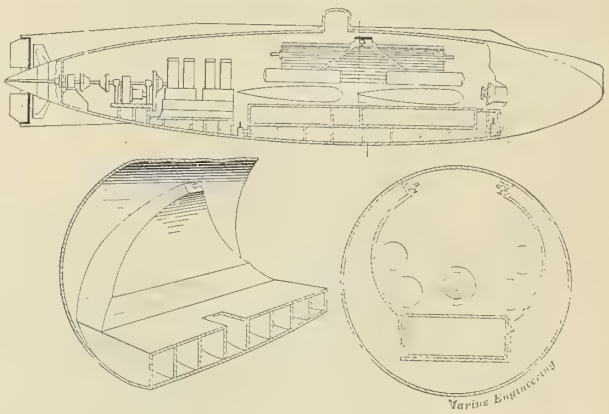
681,706. PROPELLING MECHANISM FOR VESSELS. Charles D. Jenkins, Boston, Mass.

CLAIMS.—The combination with a vessel provided with a driving shaft having a gear fastened thereto at the stem meshed with gears on two longitudinal shafts with Archimidean screws.

681,221. SUBMARINE BOAT. John P. Holland, Newark, N. J.

CLAIMS.—In a submarine boat a device for controlling the admission and discharge of water to and from the water-ballast tank.

681,222. SUBMARINE VESSEL. John P. Holland, Newark, N. J.



CLAIMS.—A submarine vessel of substantially circular cross section fitted with water-ballast tanks of horseshoe section at the bottom and sides of the boat and tapering at the fore and aft ends.

681,713. DEVICE FOR BREAKING THE SPEED OF SHIPS. Louis Lacoste, Montreal, Canada.

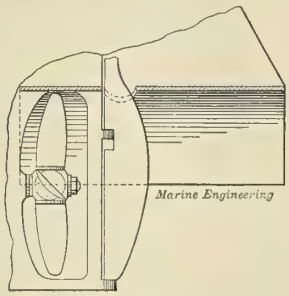
CLAIMS.—On the sides of a ship a vertical plate gate set in a recess of the plating and hinging on the after side, with appliances for opening, closing and fastening the gate.

681,873. RIVETING MACHINE. Charles J. Carney and John C. Gorton, Dunkirk, N. Y.

681,692. CONSTRUCTION OF VESSELS. Erase E. Goulaeff, St. Petersburg, Russia.

CLAIMS.—A ship's hull consisting of a portion above water line and a portion below water line, said lower portion projecting laterally beyond the upper portion, decreasing in width gradually from the middle to the ends of the ship and composed of a plurality of water-tight compartments.

682,027. PROPULSION OF VESSELS. Harold F. Burgess, Vancouver, Canada.



CLAIMS.—In combination with a hull propeller and rudder, a hood projecting rearwardly from the hull over the propeller and rudder from a point forward of the propeller, whereby the water thrown upward by the propeller will be arrested.

682,213. HYDRAULIC PROPELLER FOR SHIPS. Edmond E. Marchand, Paris, France.

CLAIMS.—A hydraulic propeller for ships comprising two turbines placed symmetrically back to back, one against the other, mounted upon a shaft having one end supported by a bearing arranged upon a slide parallel with the axle, allowing turbines and shaft to be adjusted, a casing for the turbines terminating at the forward end in a suction pipe, and at the after end in a discharge pipe located at the stem of the vessel.